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(54) **SECURE KM SWITCH**

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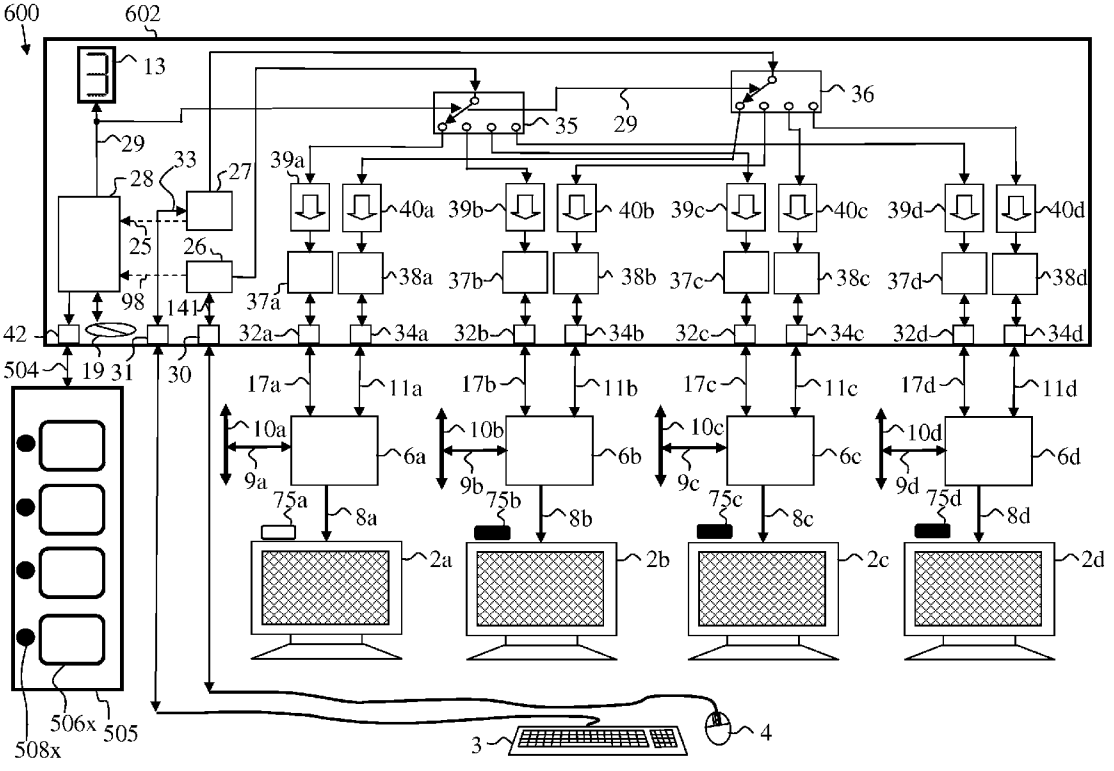
(57) **ABSTRACT**

A system enabling a computer user to securely share a single set of keyboard and mouse (KM) among multiple isolated computers. The system enables one set of peripheral devices to independently interact with multiple coupled isolated computers through mouse position analysis on a virtual display area corresponding to multiple physical user displays of the particular installation. The system may be used to enable computer user having multiple isolated computers each with one or more coupled display to automatically switch a single set of keyboard mouse and other peripheral devices between the different computers. As isolated computers may have different security levels, the method and apparatus of the present invention prevents and potential data leakages between computers and coupled networks.



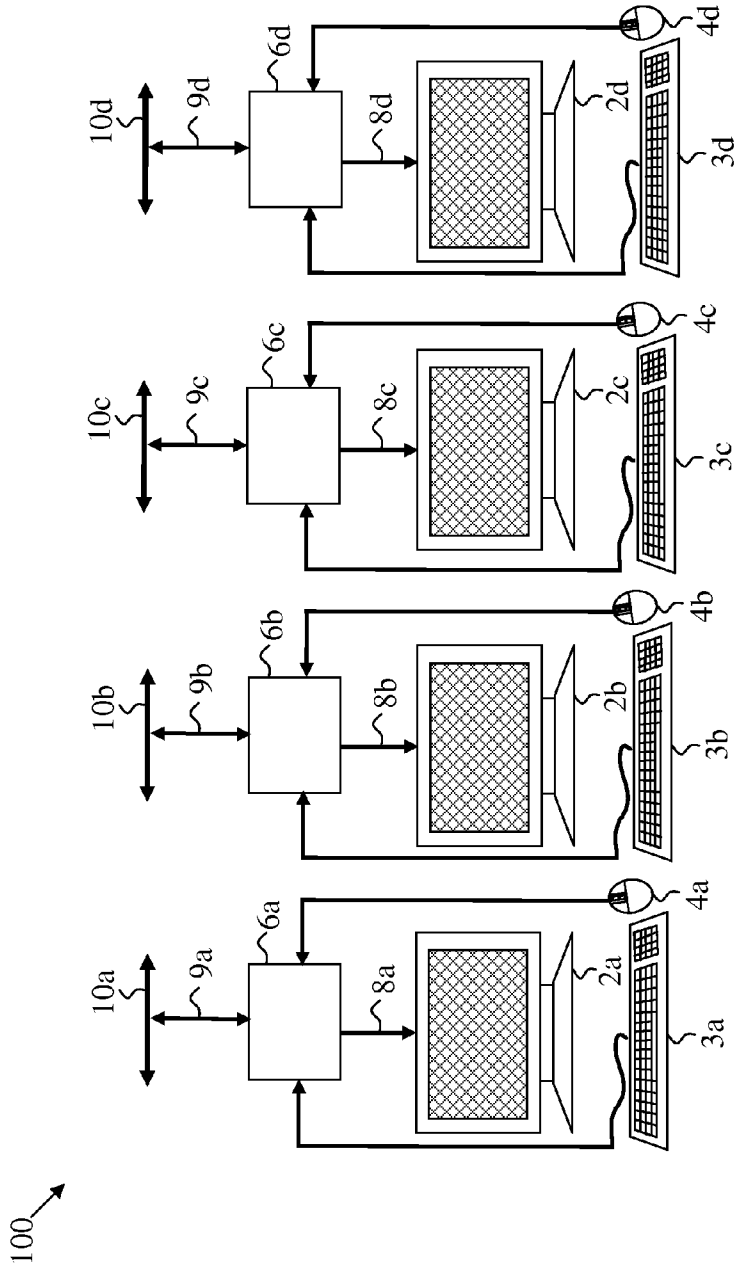


Figure 1 (Prior-Art)

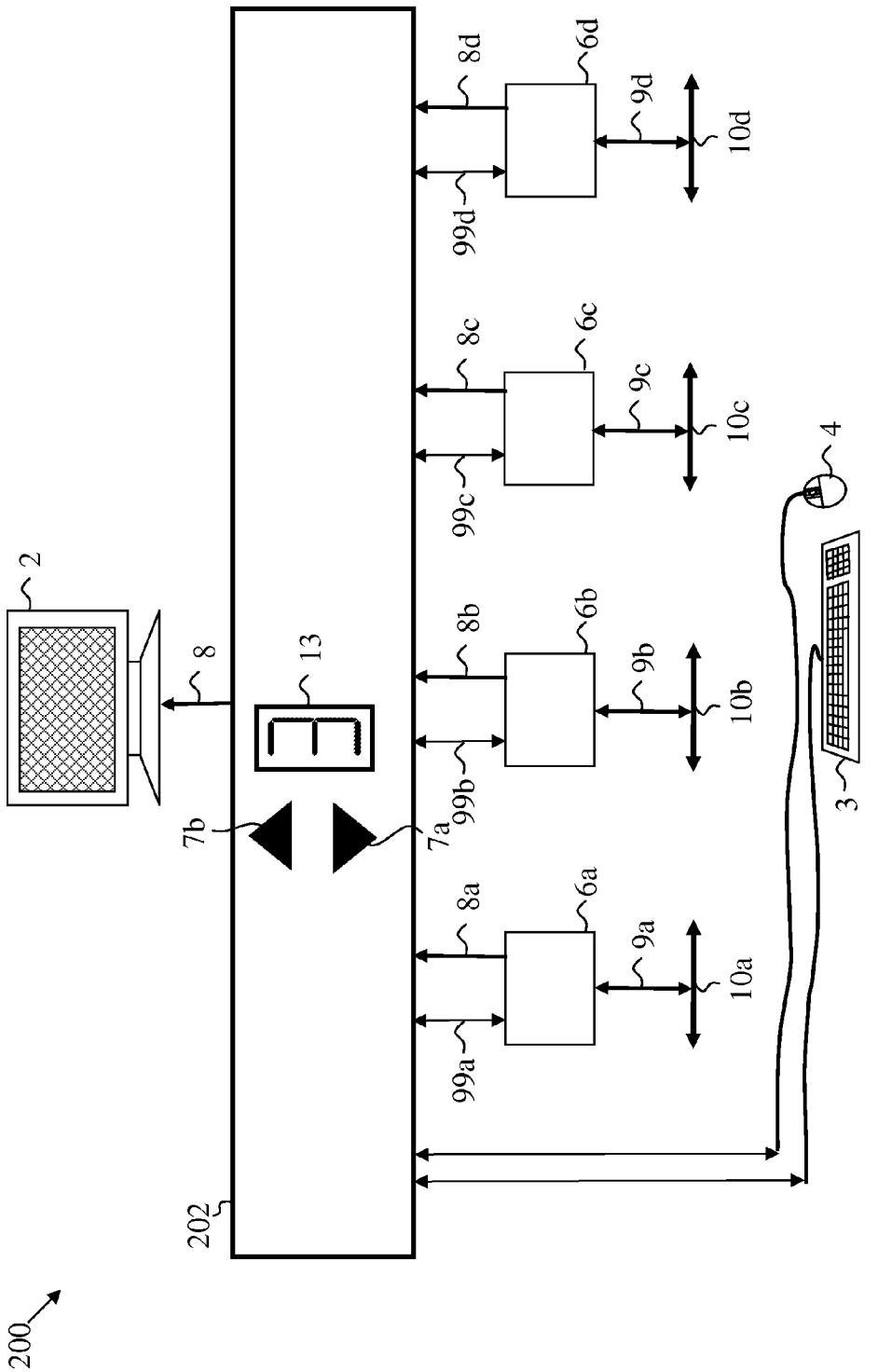


Figure 2 (Prior-Art)

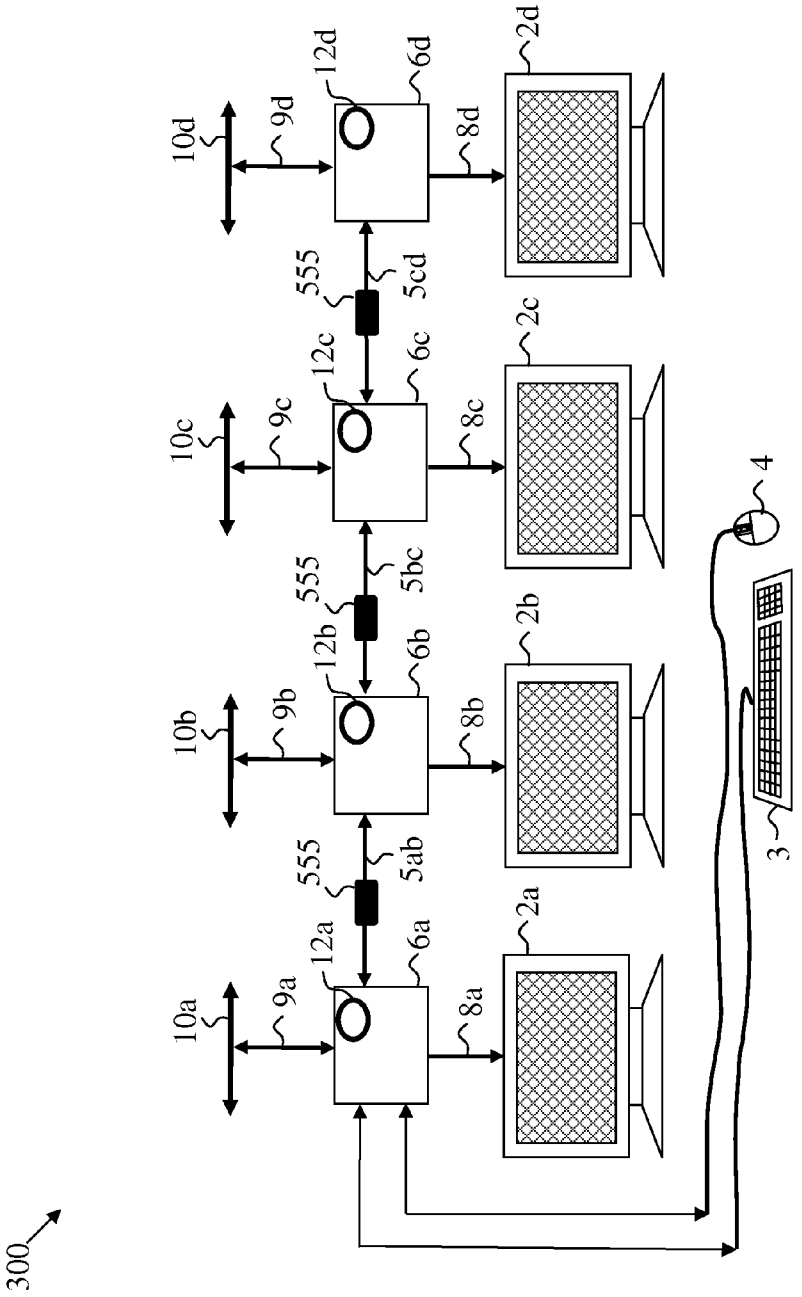


Figure 3 (Prior-Art)

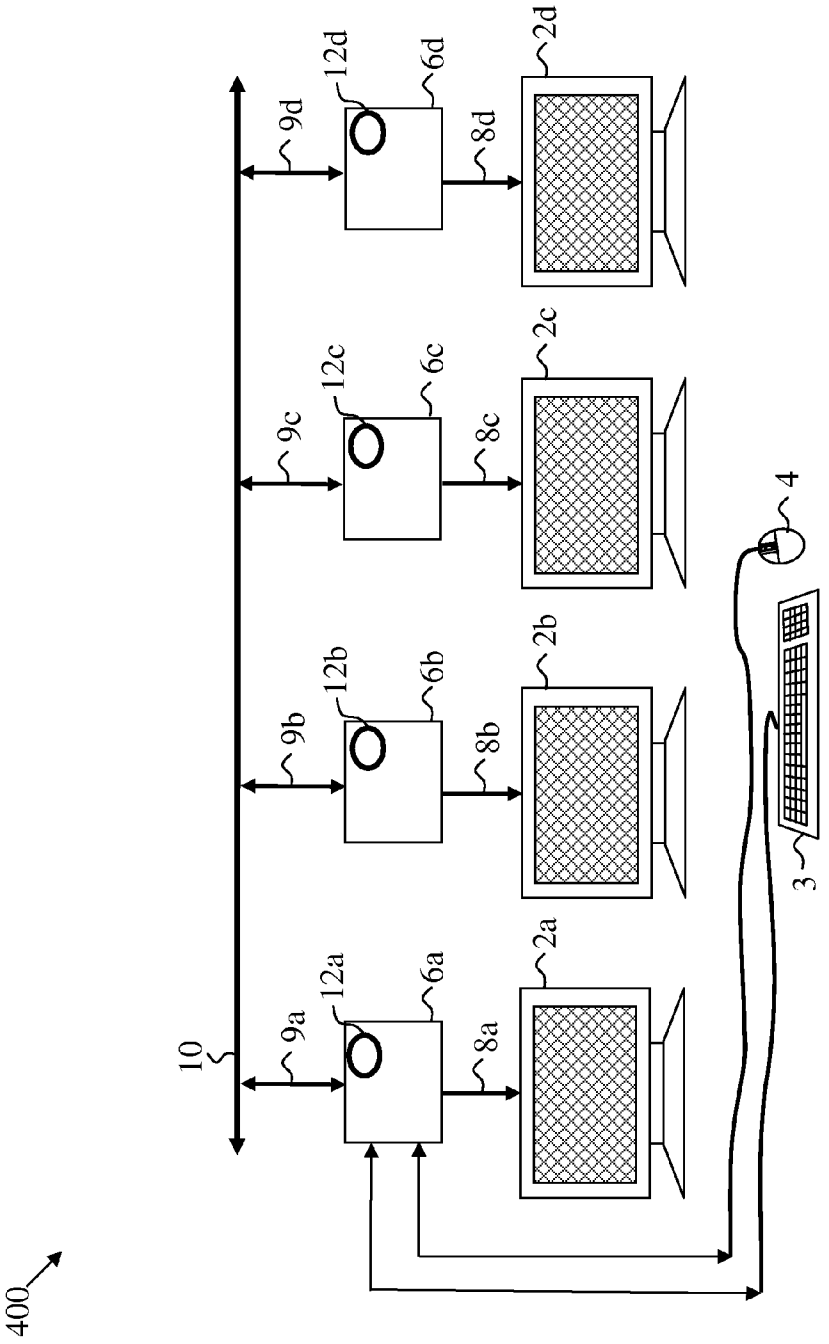
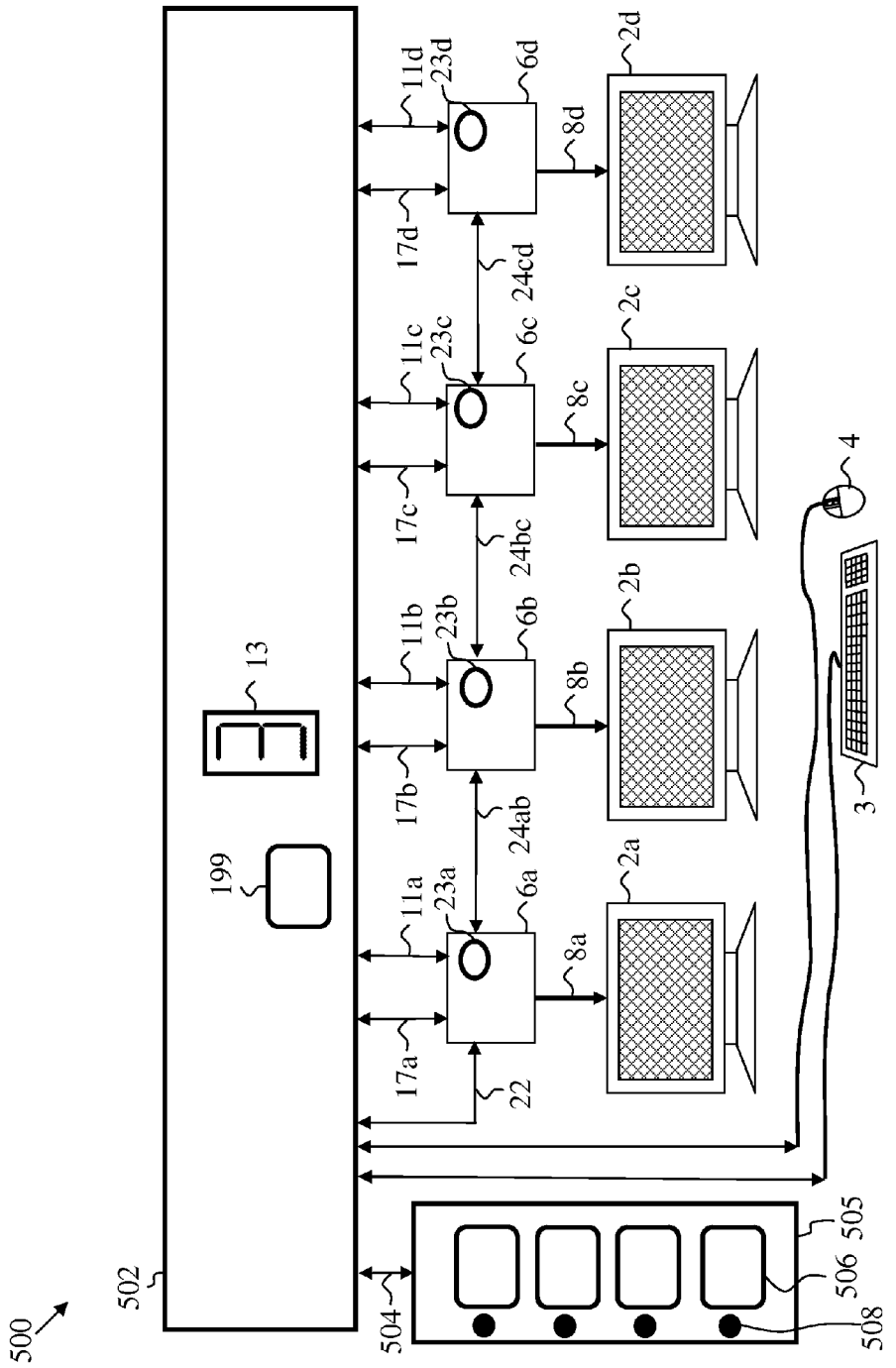


Figure 4 (Prior-Art)



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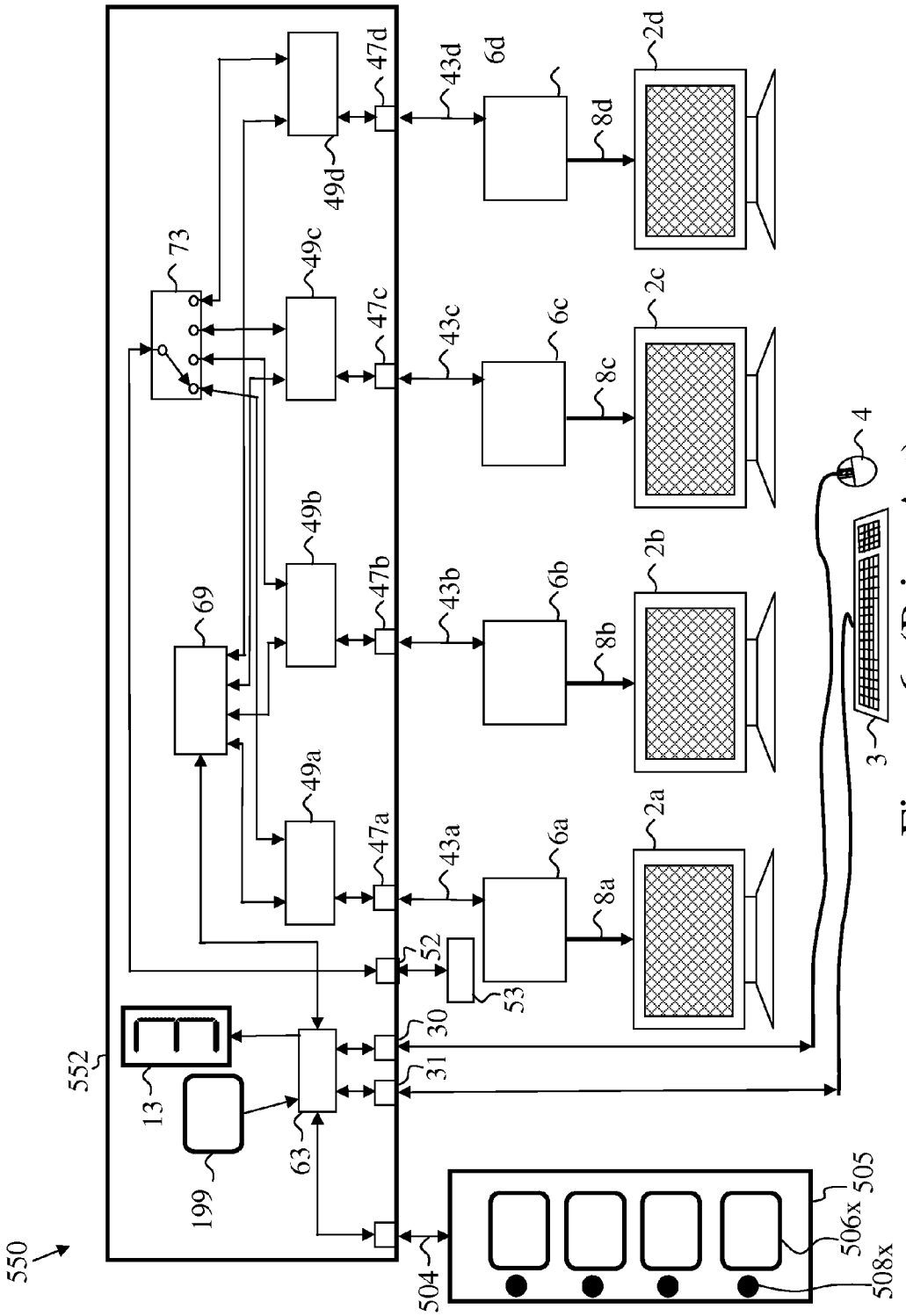

Figure 6 (Prior-Art)

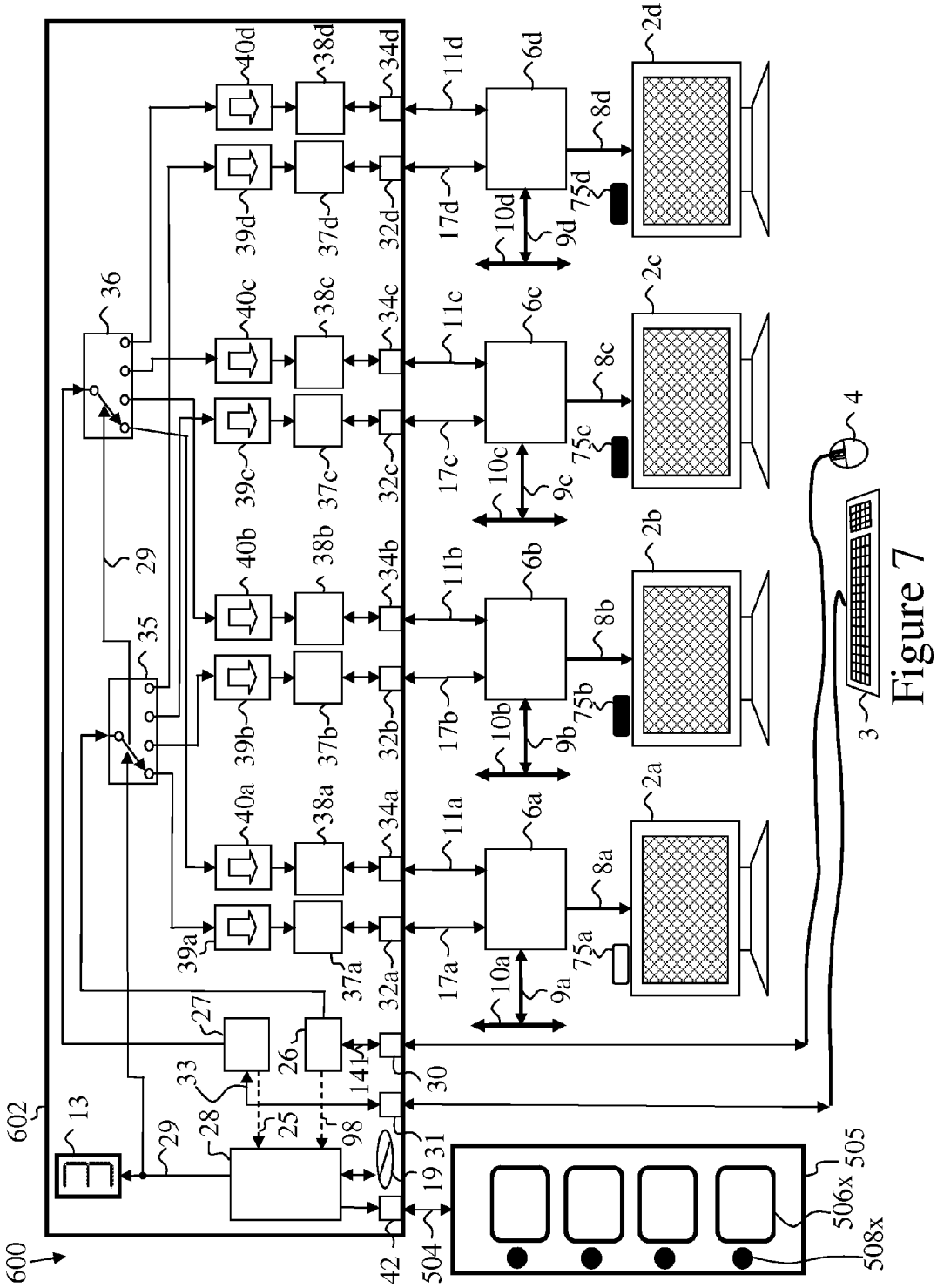
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Figure 7

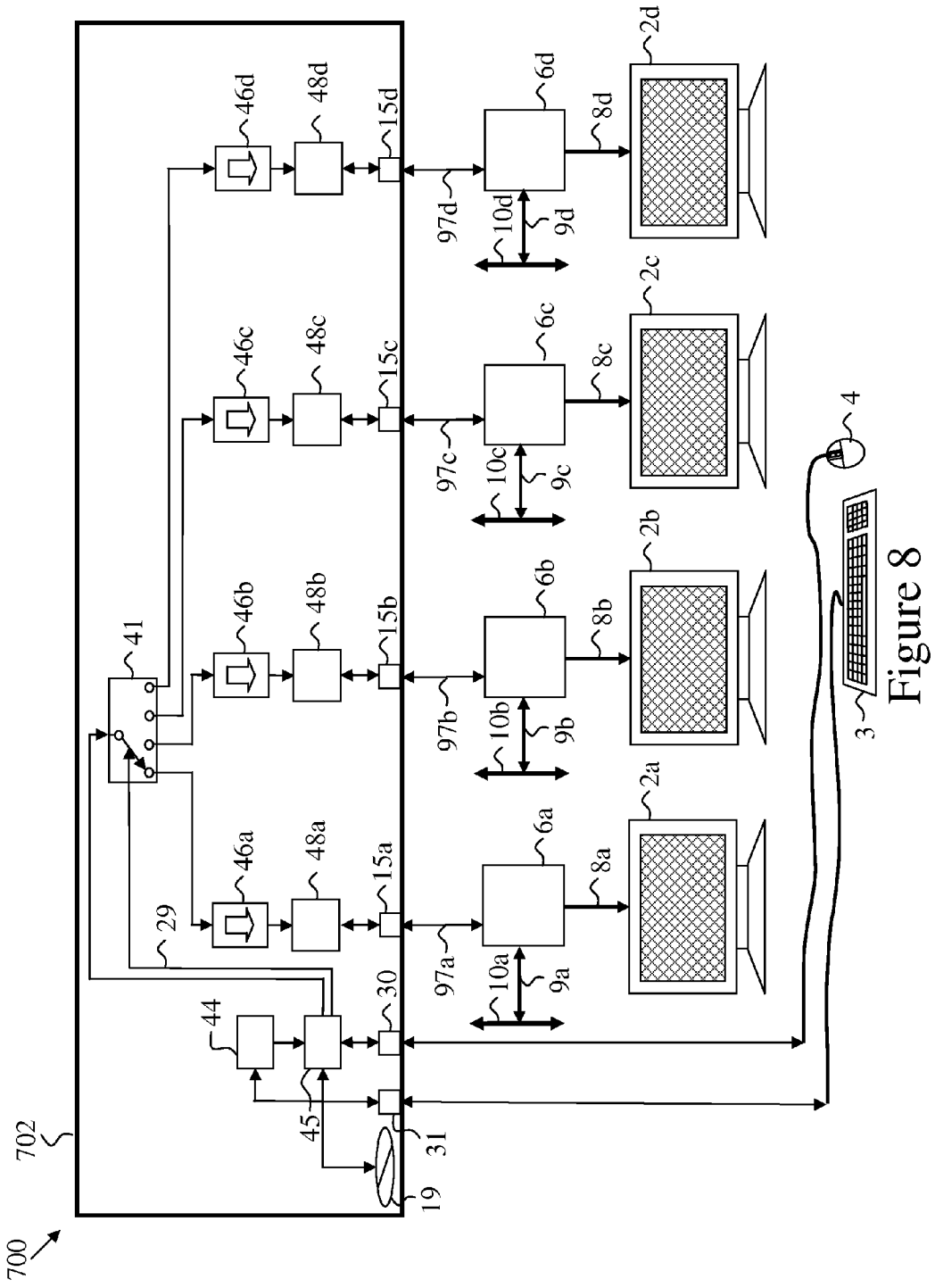
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Figure 8

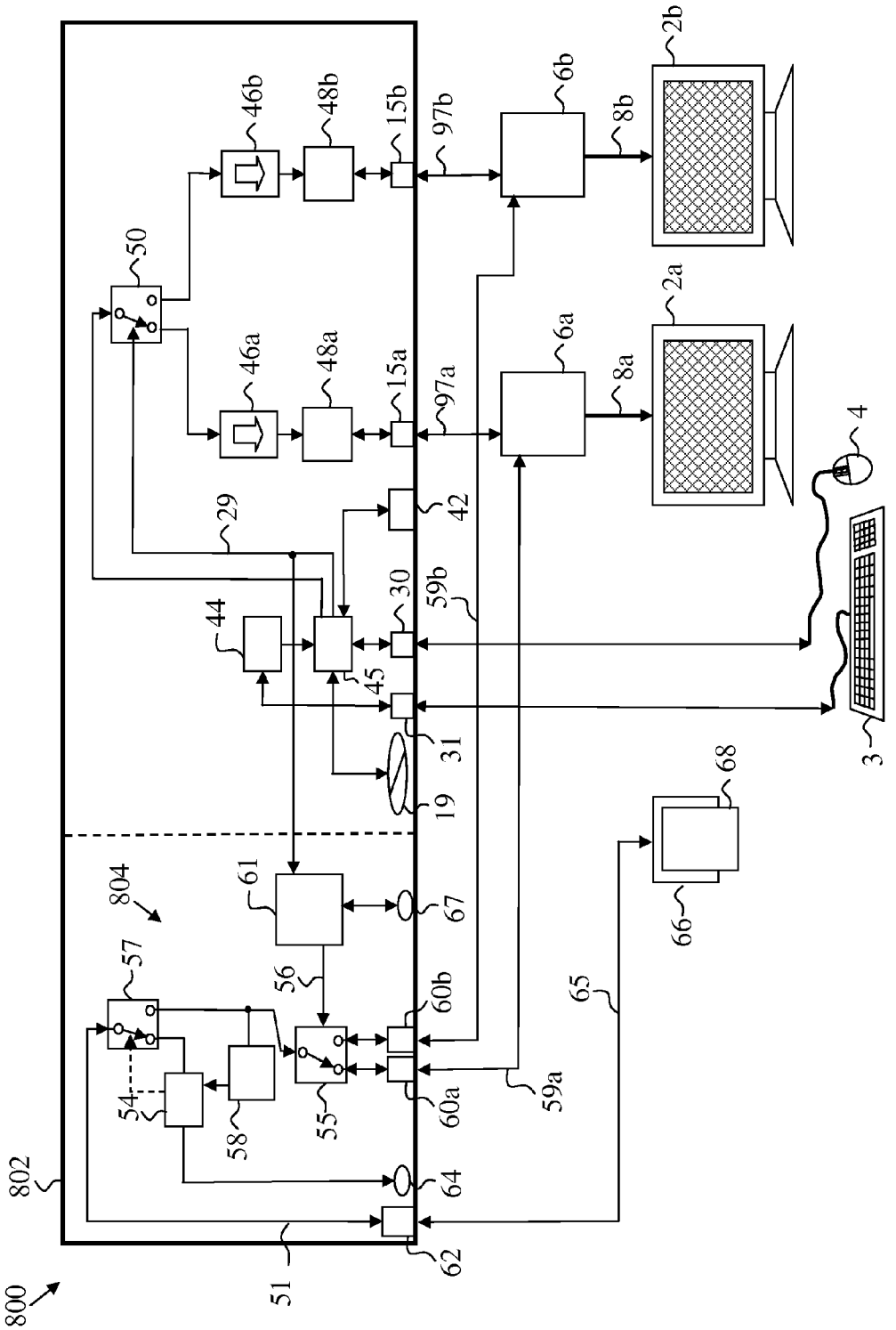
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Figure 9

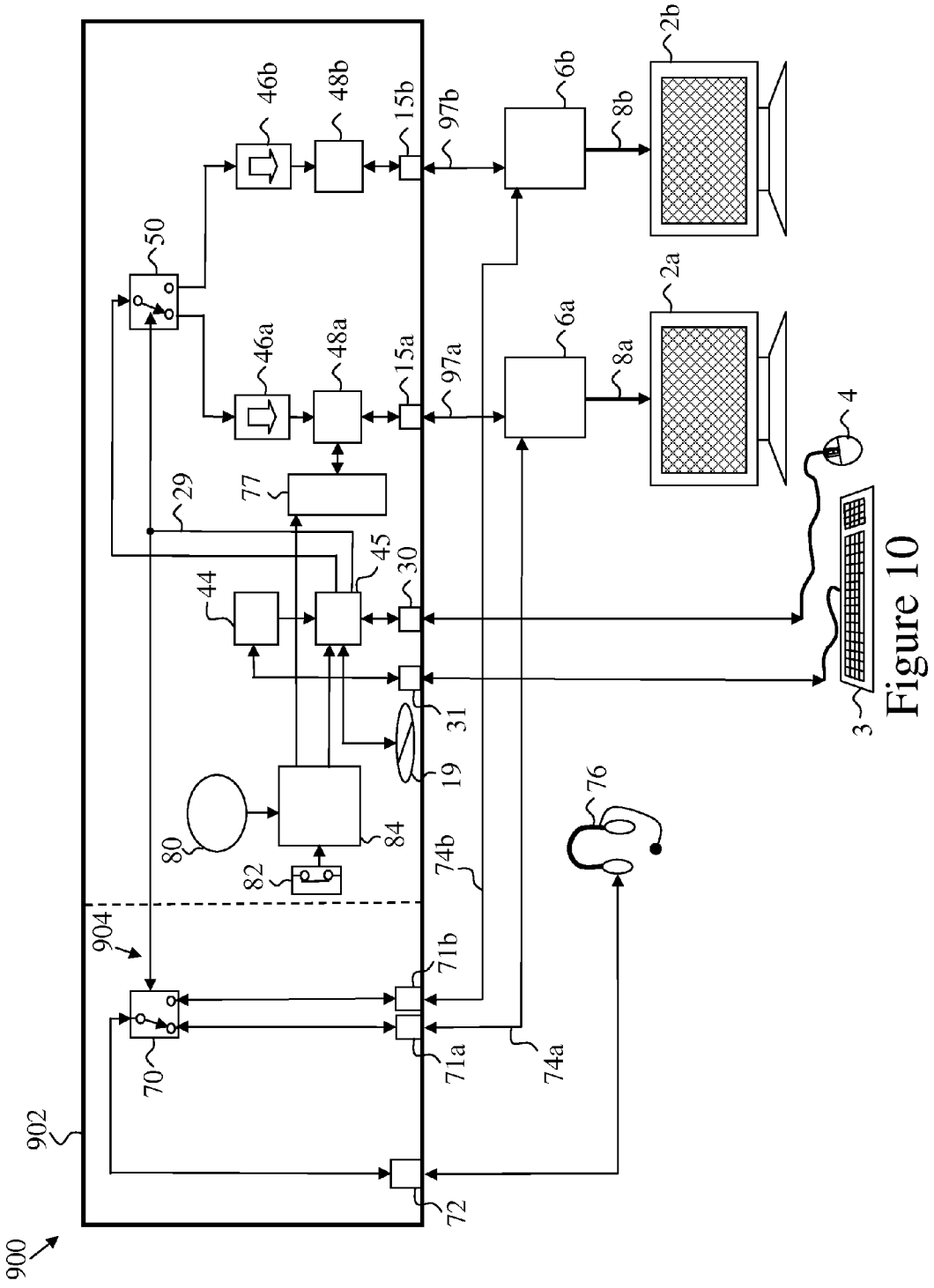
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Figure 10

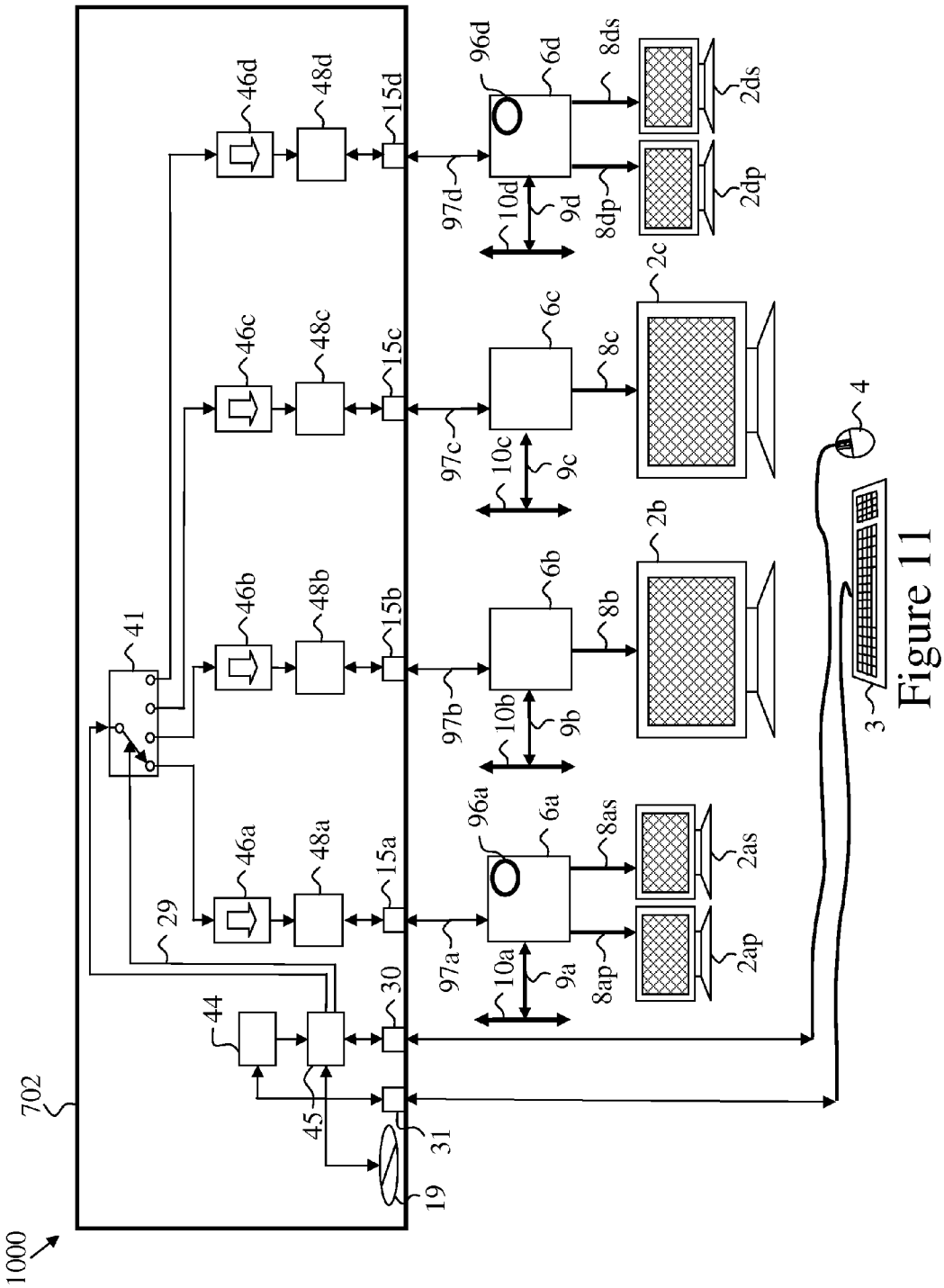
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Figure 11

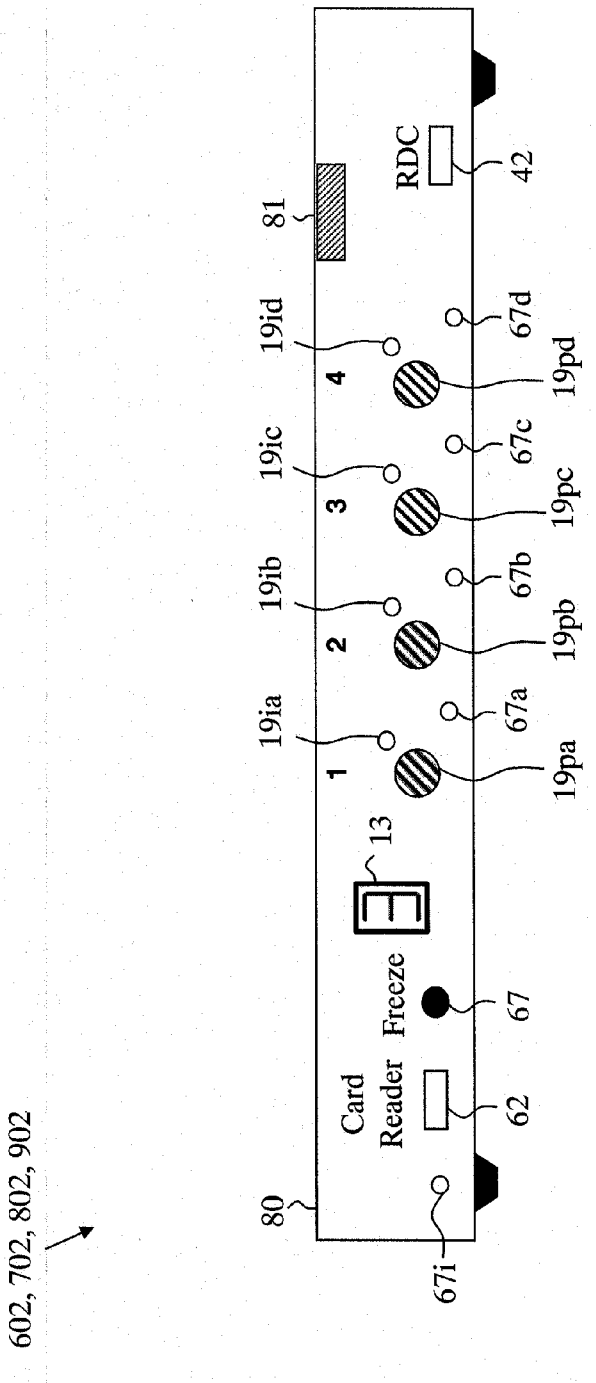
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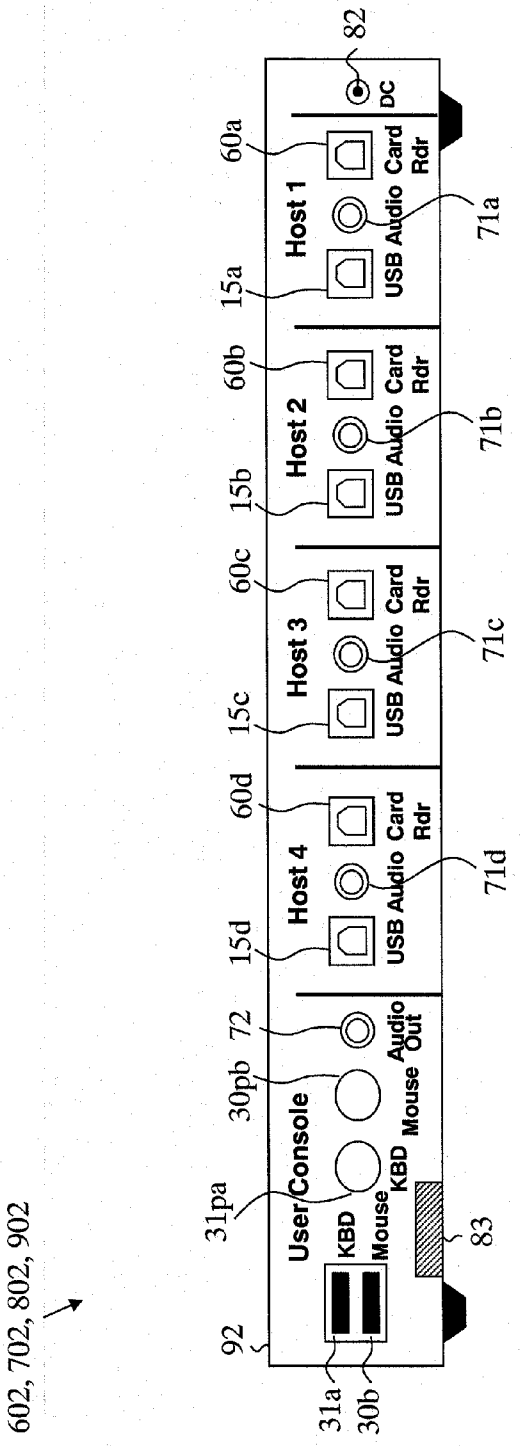
Figure 12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60a
82
83
71d
71c
71b
71a
User Console
KBD
Mouse
KBD
Mouse
Audio Out
Host 4
Host 3
Host 2
Host 1
USB Audio
Card Rdr
DC

Figure 13

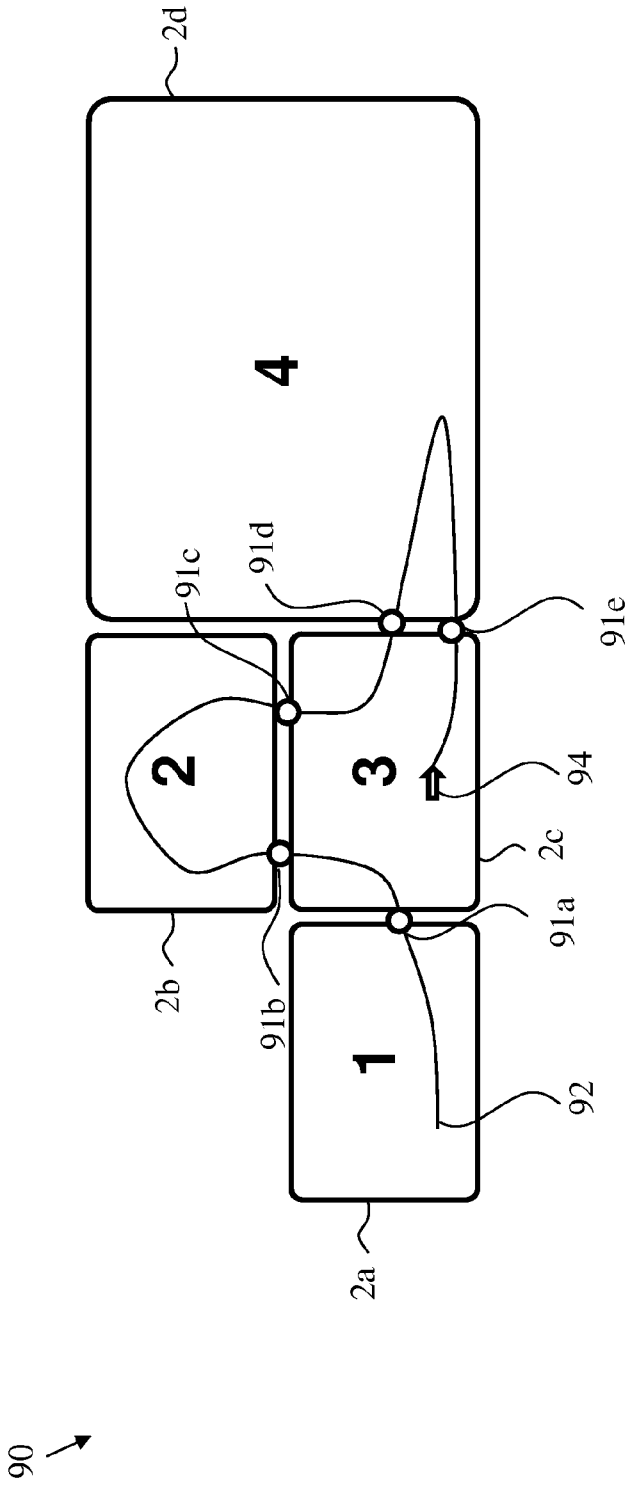
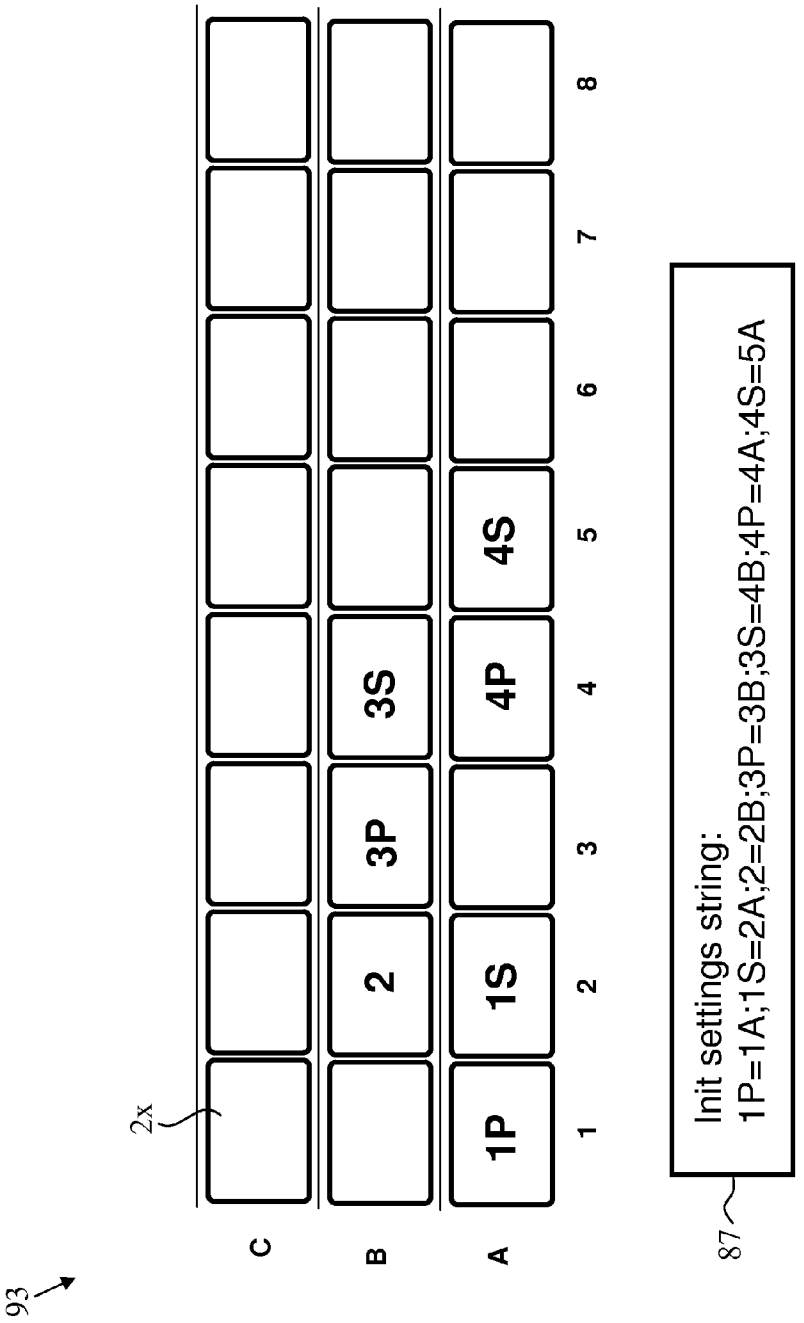


Figure 14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C
B
A
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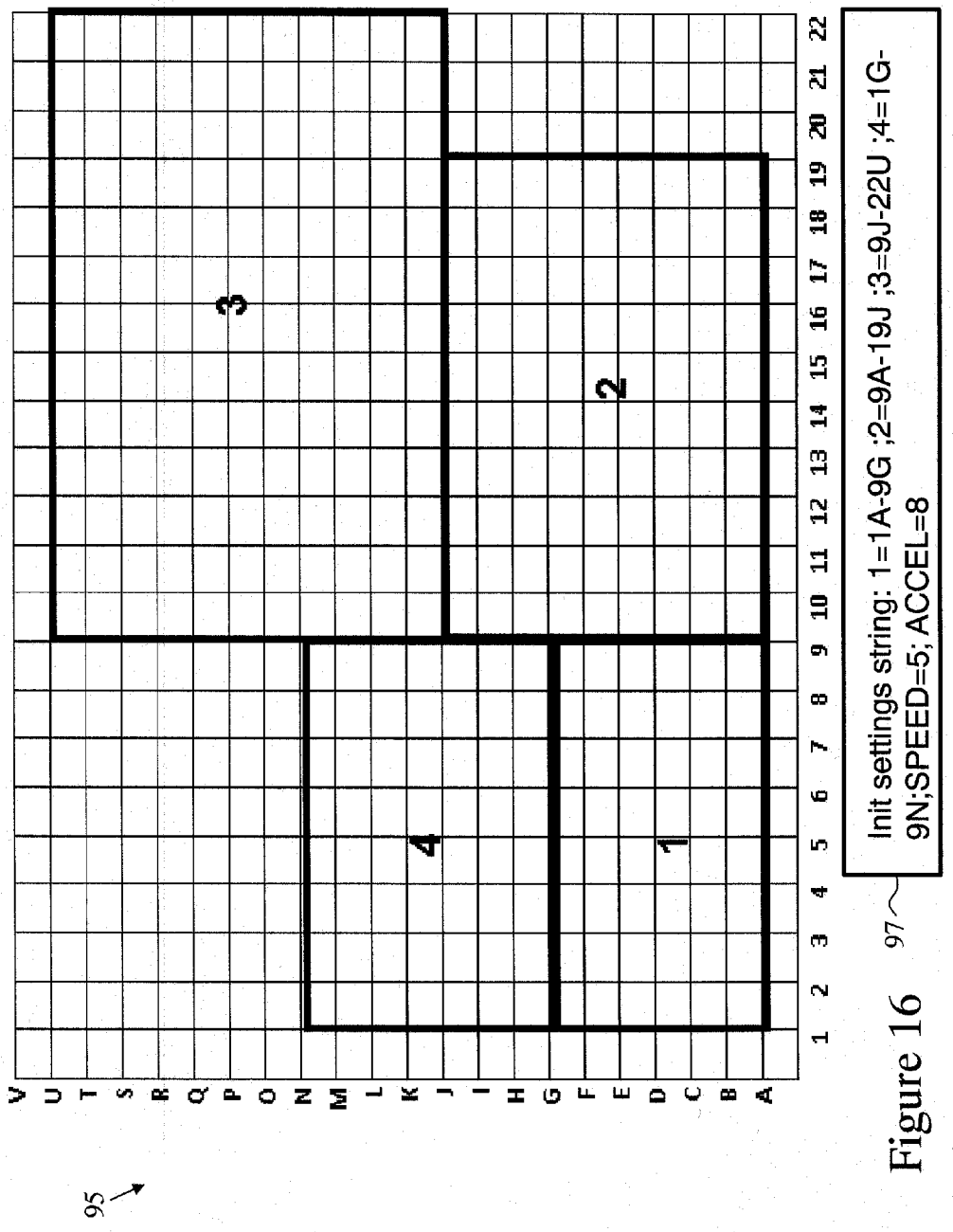
5
6
7
8
1P
1S
2
3P
3S
4P
4S
87
Init settings string:
1P=1A;1S=2A;2=2B;3P=3B;3S=4B;4P=4A;4S=5A

Figure 15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V U T S R Q P O N M L K J I H G F E D C B A
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
1
2
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4
97
Init settings string: 1=1A-9G ;2=9A-19J ;3=9J-22U ;4=1G-9N;SPEED=5; ACCEL=8

Figure 16

SECURE KM SWITCH

FIELD OF THE INVENTION

[0001] The present invention relates to a system that enables a computer user to securely share a single set of keyboard and mouse (KM) among multiple isolated computers. More particularly, the invention discloses a method apparatus and system to enable one set of peripheral devices to independently interact with multiple coupled isolated computers through mouse position analysis on a virtual display area corresponding to multiple physical user displays of the particular installation.

BACKGROUND OF THE INVENTION

[0002] There are many cases where a single user may need to access multiple isolated computing systems. Due to security reasons it may be critical that isolated computing systems will not be connected together to prevent potential data leakages and to block certain security attacks. Any peripheral device shared between two or more isolated networks may be a target for external or internal attackers. Common attack strategy is to cause a permanent or temporary data leakage path between the two coupled networks to enable data theft, unauthorized data modification or unauthorized data import. To allow a single user to operate multiple computers coupled to multiple isolated networks KVM (Keyboard Video Mouse) switch may be used. KVM switch connected to one set of user keyboard, mouse and display on one side and to multiple computers on the other side provides the user with the ability to interact with one specific computer at a time.

[0003] One specific scenario area of concern is leakage between a classified computer system or network and a non-classified network such as a network attached to the internet. Such leakage may serve as an agent inside the classified network to send classified data to unknown hostile organizations in any location in the world.

[0004] Over the past years there were several common solutions for single user operating multiple isolated computers:

[0005] 1. Using multiple displays and multiple sets of user peripheral devices.

[0006] Some organizations are enforcing isolation by placing two or more isolated sets of user peripheral devices on the user's desktop. Isolation is assured as there is no electrical contact between the multiple computers. Major disadvantage of this solution is its inherent reduced usability. Users find it hard to divert their attention between multiple systems. This solution also takes additional valuable user desktop space. If more than two isolated computers needed for a user, these usability and desktop space disadvantages tend to get worsen.

[0007] 2. Using KVM switch or Secure KVM to enable user interaction with multiple isolated computers through one set of peripherals. This solution reduces the desktop space needed and provides better usability. As conventional KVMs may leak data between coupled isolated computers, in many cases a Secure KVM is used. This type of KVM provides higher assurance that coupled computers would not leak data to one another. While this solution provides better usability, it is not suitable for users that need to see multiple displays simultaneously. Users such as traders need to see various data from multiple sources presented at all time on multiple displays. Although some secure KVMs supporting multiple displays available today, this solution tends to be less flexible and relatively expensive.

[0008] 3. Using KM (Keyboard Mouse) switch to enable user interaction with multiple isolated computers through multiple isolated displays and one set of keyboard and mouse. Shared keyboard and mouse through software or hardware KM provides access to multiple computers by means of manual switching or even continues virtual display. Unlike KVM the KM switches only the keyboard and mouse, while the display outputs are not passed or switched through the KM.

What is needed is a secure KM switch that enables secure isolation between the coupled computers. Such needed device will enable seamless user interaction with the isolated computers while viewing multiple displays. The needed secure KM switch will require minimal software and hardware installation in the coupled computers.

[0009] Information on some commercially available systems may be found in:

[0010] 1. Adder TS4 Four-port keyboard and mouse switch User's Manual (http://www.adder.com/uk/products/Manuals/TS4/ADDER_TS4_v1_1c.pdf)

[0011] 2. Adder CCS4USB Four-port keyboard and mouse switch User's Manual (http://www.adder.com/UK/products/Manuals/CCS4-USB/AdderCCS4-USBv2-0d.pdf)

[0012] 3. Actionstar USB KM switch specifications (http://www.actionstar.com.tw/products_details.php?l=0&pro_id=81)

[0013] 4. Waterfall Remote Screen View, from Waterfall™ Security Solutions Ltd. (http://www.waterfallsecurity.com/remote-screen-view/)

[0014] 5. Multiplicity from Stardock Corporation, (http://www.stardock.com/products/multiplicity/)

OTHER REFERENCED PATENTS AND APPLICATIONS

[0015] 1. United States Patent Application 2002/0105553; to Marc Segre; "Automated Keyboard Mouse Switch".

[0016] 2. United States Patent Application 2010/0185797; to Hsi-Jung Tsai, et. al.; "Keyboard-Mouse Switch and Switching Method Thereof".

[0017] 3. U.S. Pat. No. 5,825,357; to Mark Malamud; "Continuously accessible computer system interface".

SUMMARY OF THE INVENTION

[0018] The present invention, relates to a Secure KM (Keyboard Mouse) switch to be used with multiple isolated computers and multiple displays.

[0019] More particularly, the invention presents a secure KM switch having unidirectional enforced data flow from user peripherals to coupled hosts to prevent data leakages and successful signaling attacks. Secure KM switch having the security functions disclosed herein may be used to enable single user having single set of user keyboard and mouse to comfortably interact with a plurality of isolated computing devices such as: personal computer desktops, thin-clients, laptop computers, tablet computers, PDAs, cellular phones etc.

[0020] According to an exemplary embodiment of the current invention, a secure KM switch is provided, comprising:

[0021] Keyboard peripheral port to connect a standard user keyboard through bi-directional serial interface such as USB or P/2. Inside the Secure KM Switch the peripheral port is coupled to a keyboard host emulator function connected through keyboard channel select switch to unidirectional flow forcing functions at the other side. Keyboard host emulator communicates with the user keyboard through standard bidirectional peripheral protocol such as USB or PS/2 and translates user key-codes into standard or proprietary unidirectional serial protocol. This standard or proprietary serial protocol is then passed through a unidirectional flow forcing function to assure that data will only flow from the keyboard host emulator function to the keyboard device emulator of the selected channel. A keyboard channel select switch controlled by the System Controller function switches the said standard or proprietary unidirectional serial protocol data only to one host channel at a time. In each host channel, the keyboard device emulator function translates the incoming data back into standard bi-directional keyboard data flow. A serial jack at the Secure KM switch panel couple this bi-directional data into the selected host port via a connecting cable. This keyboard peripheral security function assures that data cannot flow back into the keyboard port and also assures that only qualified keyboard will be enumerated and supported by the Secure KM switch device.

[0022] A Mouse peripheral port to connect a standard user mouse or pointing device through bi-directional serial interface such as USB or P/2. Inside the Secure KM Switch the mouse peripheral port is coupled to a mouse host emulator function connected through the mouse channel select switch to unidirectional flow forcing functions at the other side. Mouse host emulator communicates with the user mouse through standard bidirectional peripheral protocol such as USB or PS/2 and translates user mouse commands into standard or proprietary unidirectional serial protocol. This standard or proprietary serial protocol is then passed through a unidirectional flow forcing function to assure that data will only flow from the mouse host emulator function to the mouse device emulator of the selected channel. A mouse channel select switch controlled by the System Controller function switches the said standard or proprietary unidirectional serial protocol data only to one host channel at a time. In each host channel the mouse device emulator function translates the incoming data back into standard bi-directional mouse data flow. A host mouse jack at the Secure KM switch panel couple this bi-directional data into the selected host serial port via a connecting cable. This mouse peripheral security function assures that data cannot flow back into the mouse port and also assures that only qualified mouse will be enumerated and supported by the Secure KM Switch device.

[0023] Approved user authentication device may be coupled into the Secure KM Switch user authentication device dedicated port that is coupled to the user authentication device mode switch. During initial connection or power up, this switch couples the user authentication device dedicated port into the qualification microcontroller function. This qualification microcontroller function enumerates the coupled user authentication device and checks if it is a qualified device based on preprogrammed qualification criterions. The same qualification microcontroller function drives the said user authentication device mode switch. Once the device is qualified the qualification microcontroller move the user authentication device mode switch to couple the connected device to one of the host ports through channel select switch controlled by the System Controller function. Each one of the

[0024] One enhancement of this security function is through the use of a monitoring function that monitors the peripheral port and the traffic after initial qualification to detect certain abnormalities. Once an abnormality is being detected, the monitoring function drives the qualification microcontroller to revert back to qualification mode.

[0025] In some embodiments the additional circuitry is comprises a monitor-able USB hub, and wherein said peripheral switch is coupled to one peripheral port through the monitor-able USB hub.

[0026] Another further enhancement of this security function is achieved through additional physical/electrical port monitoring function. This function detects physical connector removal, current draw to the device or ground plane continuity to alert the qualification microcontroller in case that device was disconnected from the port.

[0027] Alternative embodiment of the present invention may be implemented using a dedicated user authentication peripheral port coupled to a user authentication port host emulator. This host emulator is coupled through a standard or proprietary bidirectional communication link to a user authentication device emulator that is coupled into the channel select switch and coupled computers peripheral port. This arrangement prevents direct read-write access between the computer port and the device and therefore reduces the risk of data leakages through attacks on the user authentication system.

[0028] In some embodiments the qualification controller, host emulator, device emulator are field programmable to enable field customization to specific peripherals.

[0029] In some embodiments of the present invention a Trusted Platform Module (TPM) may be added on the Secure KM Switch to further enhance computer security. TPM may be coupled to above mentioned peripheral security functions to enable reporting and logging of suspected peripheral ports attack events. It should be noted that peripheral attack events may be aimed at computer ports side (internal attacks) or at the secure port side (external attack).

[0030] TPM or anti-tampering events and logs may be routed to a coupled host or through a dedicated out-of-band management channel. A trust chain from one or more of the coupled trusted computers may be extended to the secure KM switch using TPM authentication.

[0031] In some embodiments of the present invention the Secure KM Switch is further having audio switching circuitry to enable computer audio out or audio in channel switching synchronously or asynchronously with the channel selection.

[0032] Another aspect of the invention is to provide a secured multi-computer system using a KM switch comprising:

a secure KM switch apparatus comprising: a user keyboard port capable of interfacing with a user keyboard; a keyboard host emulator to emulate computer host coupled to user keyboard port on one side and to keyboard channel select switch on the other side; at least one unidirectional flow forcing circuitry to assure that data is only flowing from keyboard channel select switch to coupled keyboard device emulators and no other data may flow from the keyboard device emulators back to the keyboard channel select switch and to the coupled keyboard host emulator; a keyboard channel select switch controlled by System Controller function to connect only one selected channel keyboard device emulator to the

said unidirectional flow forcing circuitry at a time; a plurality of keyboard device emulators, to emulate a standard keyboard or replicated identity of user keyboard for each one of the coupled computer channels through host keyboard ports; a plurality of host keyboard ports for coupling coupled computers through cables; a user mouse port to connect a standard user mouse or pointing device; a mouse host emulator to emulate computer host coupled to user mouse port on one side and to mouse channel select switch on the other side; at least one unidirectional flow forcing circuitry to assure that data is only flowing from said mouse channel select switch to coupled mouse device emulators and no other data may flow from the mouse device emulators back to the mouse channel select switch and to the coupled mouse host emulator; a mouse channel select switch controlled by System Controller function to connect only one selected channel mouse device emulator at a time to the said unidirectional flow forcing circuitry; a plurality of mouse device emulators to emulate standard mouse device for each one of the coupled computer channels through host mouse ports; a plurality of host mouse ports for coupling coupled computers through cables; and a System Controller function to control said keyboard channel select switch and mouse channel select switch based on user inputs;

[0033] and at least a first and a second mutually isolated computer systems, each comprising: a computer having: a computer keyboard port coupled through said cables to said respective host keyboard port; a computer mouse port coupled through said cables to said respective host mouse port; and a display coupled to said computer,

[0034] wherein: only one of said first and second computer systems is controlled bay said user keyboard and user mouse at the time, and no information may be exchanged between said first and second mutually isolated computer systems through said secure KM switch apparatus.

[0035] In some embodiments the first and second computer systems are connected to a first and a second different networks, and no information may be exchanged between said first and second networks through said secure KM switch apparatus.

[0036] Yet another aspect of the invention is to provide a method of securely coupling a plurality of computer systems to a single keyboard and a single mouse comprising: connecting a single user mouse a host emulator capable of extracting mouse commands from said user mouse; selecting one of a plurality of isolated computer systems to receive said extracted mouse commands; passing said extracted mouse commands to said selected isolated computer system through a unidirectional flow forcing circuitry and a device emulator.

[0037] In some embodiments the method further comprises connecting a single user keyboard a host emulator capable of extracting mouse commands from said user keyboard; and passing said extracted keyboard commands to said selected isolated computer system through a unidirectional flow forcing circuitry and a device emulator.

[0038] In some embodiments passing the extracted keyboard commands to the selected isolated computer system is through a keyboard device emulator; and passing the extracted mouse commands to the selected isolated computer system is through a mouse device emulator.

[0039] Unlike the prior-art KVMs or Secure KVMs this KM does not affect the video output of the coupled computers. Each one of the computers or video sources coupled to the Secure KM Switch system is independently coupled to a single or multiple isolated displays.

[0040] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, suitable methods and materials are described below. In case of conflict, the patent specification, including definitions, will control. In addition, the materials, methods, and examples are illustrative only and not intended to be limiting.

BRIEF DESCRIPTION OF THE OF THE DRAWINGS

[0041] Some embodiments of the invention are herein described, by way of example only, with reference to the accompanying drawings. With specific reference now to the drawings in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion of the preferred embodiments of the present invention only, and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the invention. In this regard, no attempt is made to show structural details of the invention in more detail than is necessary for a fundamental understanding of the invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the invention may be embodied in practice.

[0042] In the drawings:

[0043] FIG. **1** illustrates a high-level block-diagram of a prior-art multiple isolated computers system having multiple independent displays and independent keyboards and mice.

[0044] FIG. **2** illustrates another high-level block-diagram of a prior-art multiple isolated computers system having a conventional KVM to enable use of a single set of user keyboard, mouse and display.

[0045] FIG. **3** illustrates yet another high-level block-diagram of a prior art multiple computers system having serial interconnect cables and local software applications to synchronize a single set of user keyboard and mouse with multiple connected computers.

[0046] FIG. **4** illustrates a high-level block-diagram of yet another prior art multiple computers system having common LAN (Local Area Network) interconnect and local software applications to synchronize a single set of user keyboard and mouse with multiple connected computers.

[0047] FIG. **5** illustrates another high-level block-diagram of a prior art multiple computers system having multiple independent display and a non-secure KM switch. In this system computers are linked together with serial interconnect cables to enable synchronized user interaction with multiple connected computers through a single set of user keyboard and mouse.

[0048] FIG. **6** illustrates another high-level block-diagram of a prior art multiple computers system having multiple independent display and a non-secure KM switch. In this system computers are not linked together with serial interconnect cables. Mouse host emulation enables user pointer location tracking by the KM switch.

[0049] FIG. **7** illustrates a high-level block-diagram of a system having multiple displays coupled directly to the multiple computers and having a secure KM switch to enable user

interaction with a single set of keyboard and mouse according to an exemplary embodiment of the present invention.

[0050] FIG. **8** illustrates a high-level block-diagram of a system having multiple displays coupled directly to the multiple computers and having a secure KM switch with some integrated emulation functions to enable user interaction with a single set of keyboard and mouse according to another exemplary embodiment of the present invention.

[0051] FIG. **9** illustrates a high-level block-diagram of a system similar to FIGS. **7** and **8** above; having a secure KM switch with additional dedicated peripheral port function according to an exemplary embodiment of the present invention.

[0052] FIG. **10** illustrates a high-level block-diagram of a system similar to FIGS. **7**, **8** and **9** above having a secure KM switch with additional audio switching and active anti-tampering functions according to another exemplary embodiment of the present invention.

[0053] FIG. **11** illustrates a high-level block-diagram a system similar to FIGS. **7** and **8** above having a secure KM switch with two coupled computers each driving dual displays according to yet another exemplary embodiment of the present invention.

[0054] FIG. **12** illustrates a front panel layout according to an exemplary embodiment of the present invention.

[0055] FIG. **13** illustrates a rear panel layout according to an exemplary embodiment of the present invention.

[0056] FIG. **14** illustrates an exemplary display arrangement to better illustrate the cursor tracking channel select mode of exemplary embodiment of the present invention.

[0057] FIG. **15** illustrates a method to be used to enable secure KM switch displays setting programming for a plurality of identical displays according to an exemplary embodiment of the current invention.

[0058] FIG. **16** illustrates a method to be used to enable secure KM switch displays and user settings programming according to an exemplary embodiment of the current invention. In this figure coupled displays are of different size.

DETAILED DESCRIPTION OF THE DRAWINGS

[0059] Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not necessarily limited in its application to the details set forth in the following description or exemplified by the examples. The invention is capable of other embodiments or of being practiced or carried out in various ways.

[0060] It will be appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination or as suitable in any other described embodiment of the invention. Certain features described in the context of various embodiments are not to be considered essential features of those embodiments, unless the embodiment is inoperative without those elements.

[0061] In discussion of the various figures described herein below, like numbers refer to like parts. The drawings are generally not to scale. For clarity, non-essential elements may have been omitted from some of the drawing.

[0062] FIG. **1** illustrates a high-level block diagram presenting of a prior art system **100** having 4 isolated computers **6***a* to **6***d* each coupled to a separate local area network (LAN) **10***a* to **10***d* through LAN cables **9***a* to **9***d* respectively.

[0063] The 4 isolated computers **6***a* to **6***d* are also independently coupled to one user display **2***a* to **2***d* through video cables **8***a* to **8***d* respectively. Isolated computers **6***a* to **6***d* may comprised of Personal Computers, Portable computers, docking stations, Personal Digital Assistant, Smart Phones, Thin-clients, Servers, workstations, terminals etc.

[0064] User displays **2***a* to **2***d* may be identical type and size or different type or size. User displays may be arranged in horizontal line in front of the user or in any other desired arrangement visible to the user.

[0065] Each one of the 4 computers **6***a* to **6***d* is further coupled to its independent keyboard **3***a* to **3***d* and mouse **4***a* to **4***d*.

[0066] While this prior art system **100** assures that computers **6***a* to **6***d* would not leak information between each other or between coupled networks **10***a* to **10***d*, it lacks the ease of use from the user stand-point. The use of 4 different sets of display keyboard and mouse take a large desktop area and may confuse the user. In many cases users will tend to reject this prior-art system due to these and other usability issues.

[0067] FIG. **2** illustrates a high-level block diagram of another prior-art system **200**. This system **200** is having a 4 channels KVM device **202** to improve system usability. KVM device **202** may be a conventional KVM, KVM Combiner, Secure KVM or any other type of switching appliance to enable sharing of keyboard **3**, mouse **4**, and display **2** with 4 coupled computers **6***a* to **6***d*. The 4 computers **6***a* to **6***d* are typically coupled to 4 isolated networks (LAN or WAN **10***a-d*) through 4 LAN cables **9***a* to **9***d* respectively. In this prior art system the user uses a single keyboard **3** and mouse **4**, switched by the KVM device **202** to access one of the coupled computers **6***a* to **6***d*. The user may select one of the 4 KVM channels by pressing channel down key **7***a* or channel up key **7***b* and see the number of the selected channel in display **13**. User may also select a channel by typing a pre-programmed key sequence in attached keyboard **3** or by mouse keys and pointer selection if KVM **202** is a KVM Combiner capable of intercepting and interpreting such key sequences or pointer selections.

[0068] Computers **6***a* to **6***b* are coupled to the KVM **202** through video output cables **8***a* to **8***b* and peripheral cables **99***a* to **99***d* that are typically Universal Serial Bus (USB) type cables. User display **2** is connected to the KVM **202** through display output cable **8**. KVM **202** switches user selected channel video into the attached display **2**.

[0069] This prior art system may be properly isolated and secure if a secure KVM device is used.

[0070] From operational standpoint, unless a KVM **202** is a KVM combiner—the user may not monitor all 4 computers simultaneously. The KVM **202** allows only one computer **6***a* to **6***d* generated video to be displayed in display **2**. This limitation may be difficult for users that need to monitor various real-time data presented by all 4 computers **6***a* to **6***d*.

[0071] One way to overcome this limitation with this system **200** is to connect 4 different displays directly to computers **6***a* to **6***d* and avoid the video switching function of the KVM **202**. While this setup may work, it does not enable mouse cursor control of selected channel.

[0072] FIG. **3** illustrates a high-level block diagram of yet another prior art system **300** having 4 computers **6***a* to **6***d* running KM (Keyboard Mouse) Switch application software **12***a* to **12***d* to enable single keyboard **3** and single mouse **4** to

interact with all 4 computers **6***a* to **6***d*. The 4 computers **6***a* to **6***d* in this system **300** are typically coupled to 4 isolated networks **10***a* to **10***d* (LAN or WAN) through 4 LAN cables **9***a* to **9***d* respectively.

[0073] User keyboard **3** and mouse **4** are connected to first computer **6***a* running KM switch application software **12***a*. Through the use of special interconnect serial cable **5***ab* application **12***a* communicates with application **12***b* of second computer **6***b*. When user moves the cursor near the right side border of attached display **2***a*, application **12***a* notifies application **12***b* through serial cable **5***ab*. Serial cable **5***ab* may be a simple passive cable or a dedicated active cable having internal electronic module **555** such as USB to USB active cable. Application **12***b* then causes the local cursor in computer **6***b* to appear at the left border of second display **2***b*. At the same time keyboard **4** is switched to the second computer **6***b* through the same path. The user may feel like operating a single desktop spanning across different displays **2***a* to **2***d* coupled to computers **6***a* to **6***b*. KM Switching applications **12***a* to **12***c* may also enable setup program to define different arrangements of user displays (in columns/rows or combination thereof).

[0074] While this prior-art system **300** provides user ease of use, it suffers from significant security disadvantages. The serial cables **5***ab*, **5***bc* and **5***cd* provide a potential data leakage path between the coupled computers and between the coupled networks. In many cases organizations would not allow such interconnect to be made as it can be used by attackers to propagate inside their classified networks. Another disadvantage of this prior-art system is that it is relying on software applications that must be installed in each of the coupled computers. This software installation is undesirable and in many cases impossible as computers may run different operating systems or implemented using custom hardware.

[0075] FIG. **4** illustrates a high-level block diagram of yet another prior-art system **400** similar to system **300** of FIG. **3** above, but in this system instead of using the serial cables **5***ab* to **5***cd*, the system uses the attached LAN **10** (Local Area Network) to communicate and synchronize between computers. This type of implementation is completely unsecure as all computers **6***a* to **6***d* must communicate on the same LAN **10**, thus computers **6***a* to **6***d* cannot be isolated.

[0076] FIG. **5** illustrates another high-level block diagram of yet another prior art system **500** having a 4 channels KM switch device **502**. These prior art KM switches sometimes called trader KM switches as they are often used in financial trader environments. The KM switch **502** is coupled to the 4 computers **6***a* to **6***d* through USB keyboard cables **11***a* to **11***d* respectively and USB mouse cables **17***a* to **17***d* respectively. Each of computers **6***a* to **6***d* is coupled with one display **2***a* to **2***d* respectively. User keyboard **3** and mouse **4** are connected to the KM switch **502** through USB or PS/2 ports. User can select between computers **6***a* to **6***d* by pressing channel toggle push button **199** while monitoring selected channel number in 7-segment display **13**. Another method of user channel selection is by user typing of a pre-defined keys sequence. Another accessory offered with some prior-art KM switches is a cable **504** connected remote controller **505**, having channel selection push buttons **506** and status LEDs **508**. This remote controller **504** may be positioned on the user desktop while KM switch **502** is remotely installed behind the desktop cabinets.

[0077] Another optional feature of this exemplary prior-art KM switch is the use of the mouse cursor to enable user channel selection (Cursor Tracking Mode). Serial cable **22** connected between the KM switch **502** and the first computer **6***a* enables communication and cursor synchronization through special installed application **23***a*. Additional serial interconnect cables **24***ab* connecting first computer **6***a* and second computer **6***b* having similar software application **23***b* installed. Serial cable **24***bc* connecting computers **6***b* and **6***c* having similar software **23***c* installed. Serial interconnect cable **24***cd* connecting computers **6***c* and **6***d* having similar software application **23***d* installed. This chain of computers **6***x*, serial interconnect cables **24***xx* and applications **23***x* enables chaining and synchronization between all coupled computers and the KM switch **502**. When the user is working in display **2***a* and computer **6***a*, the keyboard **3** and mouse **4** are switched through the KM switch **502** to computer **6***a* via USB cables **11***a* and **17***a*. Once the user moves the mouse cursor on display **2***a* close to the right side border the special application software **23***a* communicates with the special software application **23***b* through interconnecting cable **24***ab* and user mouse cursor reappears at the second display **2***b*. At the same time the KM switch **502** receive a message through cable **22** that the new channel selected is computer **6***b* and it switches the keyboard **3** and mouse **4** to the second computer **6***b* through USB cables **11***b* and **17***b*. This smooth transition between displays and computers enable seamless user control of the KM across different platform without the need to actively select a channel by pressing keys or push-buttons.

[0078] The major disadvantage of this prior-art system is the interconnect cables **24***xx* and their potential use by attackers in attempt to leak data between computers **6***x*. From security standpoint and interconnect between the computers **6***x* is undesirable. The concept of using 4 isolated computers with this KM switch is far more expensive than having a single computer with quad head connected (4 displays supported on 1 computer). The biggest motivation of building this prior-art system **500** with 4 isolated computers is security—keeping 4 isolated networks. Still this system **500** provides very little security due to the serial interconnect cables and the special software applications installed in each computer.

[0079] FIG. **6** illustrates another high-level block diagram of yet another prior art system **550** having a 4 channels KM switch device **552**. This prior art KM switch is similar to the trader KM switch illustrated in FIG. **5** above and it is used primarily in the financial sector. In this prior-art KM switch mouse position tracking function does not require serial interconnect cables between coupled computers **6***x* but still it is relatively unsecure.

[0080] The KM switch **552** is coupled to the 4 computers **6***a* to **6***d* through the peripheral USB ports **47***a* to **47***d* and peripheral cables **43***a* to **43***d* respectively.

[0081] Each of computers **6***a* to **6***d* is also coupled with one display **2***a* to **2***d* respectively. Displays **2***a* to **2***d* may be identical or different type having different native display resolution.

[0082] User keyboard **3** and mouse **4** are connected to the KM switch **552** through a USB or a PS/2 user keyboard port **31** and user mouse port **30**. User can select between computers **6***a* to **6***d* by pressing channel toggle push button **199** while monitoring selected channel number in 7-segment display **13**.

[0083] Another method of user channel selection is by user typing of a pre-defined keys sequence or hot keys. Another accessory offered with some prior-art KM switches is a cable **504** connected remote controller **505**, having channel selection push buttons **506***x* and status LEDs **508***x*. This remote

controller **504** may be positioned on the user desktop while KM switch **502** is remotely installed behind the desktop cabinets.

[0084] Another option of this prior art KM switch **552** is to switch channel according to the user mouse pointer location. This option called sometimes Free-Flow Automated Mouse Switching Technology. The cursor location is analysed according to a predefined displays setup programming. Local software application or driver is not required in computers **6***a* to **6***d* as the host emulator **63** can detect pointer location and switch the required channel accordingly.

[0085] One or more USB peripheral devices **53** coupled through one or more peripheral ports **52** enable synchronous or asynchronous switching between computer channels **6***a* to **6***d*.

[0086] Inside this prior art KM switch **552** the peripheral USB ports **47***a* to **47***d* are coupled to USB hubs **49***a* to **49***d* allocated to each computer port so that each USB hub **49***a* to **49***d* upstream port is coupled to computer **6***a* to **6***d* respectively. The downstream ports of each USB hub **49***x* are coupled to peripheral switch **73** and to the emulator engine **69**. Peripheral switch **73** controlled by the user channel selection inputs common side is coupled to the peripheral port **52**. The emulation engine **69** provides keyboard and mouse device emulation to all coupled computers. When the computer channel is not selected by the user it generates the required USB keep-alive packets. When the computer channel is selected by the user, the emulation engine **69** interacts with the host emulator **63** that is coupled to the user keyboard **3** and mouse **4**.

[0087] FIG. **7** illustrates a high-level block diagram of system **600** according to an exemplary embodiment of the current invention having a 4 channels secure KM switch device **602**.

[0088] The Secure KM switch **602** is coupled to the 4 isolated computers **6***a* to **6***d* through USB keyboard host ports **34***a* to **34***d*, USB host cables **11***a* to **11***d* respectively. Similarly the USB mouse host ports **32***a* to **32***d* are coupled through USB mouse cables **17***a* to **17***d* respectively. The 4 computers **6***a* to **6***d* in this system **600** are coupled to 4 isolated networks (LAN or WAN) **10***a* to **10***d* through 4 LAN cables **9***a* to **9***d* respectively.

[0089] Computers **6***a* to **6***d* are coupled through video cables **8***a* to **8***d* to displays **2***a* to **2***d* respectively. The 4 displays **2***a* to **2***d* are preferably similar model and can be installed in any arrangement close to one another in horizontal line, vertical line or in any other combination suitable for the user. However, different types of displays having different native display resolution may be used.

[0090] User keyboard **3** is coupled to the secure KM switch **602** through a dedicated user keyboard port **31**. User keyboard port **31** is coupled to the keyboard host emulator **27** through lines **33**. Lines **33** may have ESD protection means, EMI filters and other electrical and safety protection means not shown here to prevent cluttering. Keyboard host emulator **27** enumerate and communicate with the coupled keyboard **15** using standard bi-directional peripheral protocol such as USB or PS/2. To simplify the discussion only USB protocol will be covered hereafter. It would be apparent to a man skilled in the art to implement the invention for the case in which PS/2 or other protocols are to be used. Keyboard host emulator **27** may be a microcontroller, ASIC, FPGA or any other suitable programmable device running a pre-programmed firmware or stat machine. The firmware/state-machine is designed to enumerate, initialize and enable only keyboard class peripheral devices and reject (disable) any other coupled devices. For example the following text describes an unknown USB peripheral that is being enumerated by the Keyboard host emulator **27**:

[0091] When unknown USB peripheral device is first connected through the user keyboard port **31** to the keyboard host emulator **27**, the USB device enumeration process is started. The enumeration starts by the keyboard host emulator **27** sending a reset signal to the unknown USB device. The data rate of the unknown USB device is determined during the reset signaling. After reset, the unknown USB device's information is read by the Keyboard host emulator **27** and the device is assigned a unique 7-bit address. If the unknown device is supported by the Keyboard host emulator **27** (based on pre-programmed criterions such as device class, sub-class, Vendor ID, Product ID etc), the keyboard device will be activated or enabled, set to a configured state and will establish standard keyboard communications with the Keyboard host emulator **27**. If the secure KM switch **602** is restarted or a new peripheral device is reconnected, the above enumeration process is repeated.

[0092] Following enumeration and activation, the Keyboard host emulator **27** sends all keyboard data using a simplex serial standard protocol (such as RS-232, I2C, SPI) or proprietary unidirectional serial protocol through the keyboard channel select switch **36**. Keyboard channel select switch **36** is controlled by channel select lines **29** driven by system controller function **28**. Keyboard channel select switch **36** connects only one channel selected by the user to the unidirectional flow forcing circuitry **40***a* to **40***d* to the keyboard device emulator **38***a* to **38***d* respectively. Both keyboard host emulator **27** and keyboard device emulator **38***x* may be programmed to map and support not only basic keyboard keys but also multimedia keys, wheel, sliders and any required controls.

[0093] The unidirectional flow forcing circuitry **40***x* may be an optical isolator, electromagnetic isolator, logic driver, RF isolator or any other unidirectional device that may be used to prevent reverse flow of data from keyboard device emulator **38***x* to keyboard host emulator **27** and potentially to the dedicated keyboard peripheral port **31**. If selected by the keyboard channel select switch **36**, Keyboard device emulator **38***x* receives the standard or proprietary unidirectional keyboard data and translates it back to a standard bi-directional peripheral protocol such as USB, coupled through the keyboard host ports **34***a* to **34***d* to computers **6***a* to **6***d* via keyboard cables **11***a* to **11***d* respectively. Keyboard device emulators **38***x* may enumerate as a standard generic keyboard or may enumerate as a reflection of the specific keyboard **3** coupled to the user keyboard port **31**. Enumeration as a reflection of a specific keyboard enables support of special keyboard keys and functions that are not supported by standard keyboard.

[0094] When not selected by the keyboard channel select switch **36** (channel is inactive), keyboard device emulators **38***x* generates required keep alive traffic to prevent coupled computers **6***x* from disconnect the emulated keyboard device thus preventing re-enumeration delays once that emulator is selected again by the user. Periodic keep alive packets are needed according to the USB standard to prevent the USB bus from entering an idle state when data is not passed on it.

[0095] Keyboard device emulators **38***x* may be a microcontroller, ASIC, FPGA or any other suitable programmable device running a pre-programmed firmware or stat-machine.

Both keyboard host emulator **27** and keyboard device emulators **38***x* may be implemented with ROM (Read Only Memory), Fuse protected flash, One Time Programmable (OTP) or other suitable non-volatile memory technology to prevent re-programming security attacks on controllers from the user keyboard port **31** side or from the keyboard host ports **34***x* side.

[0096] Keyboard host emulator **27** is programmed to support only characterized keyboard devices. If the user or attacker attempts to connect a USB hub instead, the device will not be qualified and will be disabled. If the user or attacker attempts to connect a composite device having more than one peripheral functions, the Keyboard host emulator **27** will enumerate and enable only one keyboard device contained in the composite device (if exist). If no keyboard device exists in the composite device, the whole device will be disabled.

[0097] Similarly, user mouse **4** is coupled through a cable to a dedicated user mouse port **30**. Dedicated user mouse port **30** is coupled to the mouse host emulator **26** through lines **141**. Lines **141** may have ESD protection means, EMI filters and other electrical and safety protection means not shown here to prevent cluttering. Mouse host emulator **26** enumerate and communicate with the coupled mouse **4** using standard bi-directional peripheral protocol such as USB or PS/2. To simplify the discussion only USB will be covered hereafter. Mouse host emulator **26** may be a microcontroller, ASIC, FPGA or any other suitable programmable device running a pre-programmed firmware or stat-machine. The firmware or state-machine is designed to enumerate and enable only mouse class peripheral devices and reject (disable) any other coupled devices. For example the following text describes an unknown USB peripheral that is being enumerated by the mouse host emulator **26**:

[0098] When an unknown USB peripheral device is first connected to the mouse host emulator **26**, the USB device enumeration process is started. The enumeration starts by the mouse host emulator **26** sending a reset signal to the unknown USB device. The data rate of the unknown USB device is determined during the reset signaling. After reset, the unknown USB device's information is read by the mouse host emulator **26** and the device is assigned a unique 7-bit address. If the unknown device is supported by the mouse host emulator **26** (based on pre-programmed criterions such as device class, sub-class, Vendor ID, Product ID etc), the mouse device will be activated or enabled, set to a configured state and will establish standard mouse communications with the mouse host emulator **26**. If the secure KM switch **602** is restarted or a new peripheral device is reconnected, the above enumeration process is repeated.

[0099] Following enumeration and activation, the Mouse host emulator **26** sends all mouse data (horizontal movement, vertical movement, wheel, mouse keys etc) using a standard or proprietary unidirectional serial protocol through the mouse channel select switch **35**. Mouse channel select switch **35** is controlled by channel select lines **29** driven by system controller function **28**. Mouse channel select switch **35** connects only one channel selected by the user to the unidirectional flow forcing circuitry **39***a* to **39***d* to the mouse device emulator **37***a* to **37***d* respectively. Both Mouse host emulator **26** and mouse device emulators **37***x* may be programmed to map and support not only mouse movements but also mouse keys, wheel and any required controls.

[0100] Mouse device emulators **37***x* may enumerate as a standard generic mouse or may enumerate as a reflection of the specific mouse **3** coupled to the user mouse port **30**. Enumeration as a reflection of a specific mouse enables support of special keys and functions that are not supported by standard mouse.

[0101] The unidirectional flow forcing circuitry **39***x* may be an optical isolator, electromagnetic isolator, logic driver, RF isolator or any other unidirectional device that may be used to prevent reverse flow of data from mouse device emulators **37***x* to mouse host emulator **26** and potentially to the dedicated user mouse port **30**. If selected by the mouse channel select switch **35**, mouse device emulators **37***x* receives the standard or proprietary unidirectional mouse data and translates it back to a standard bi-directional peripheral protocol such as USB, coupled to the computers **6***a* to **6***d* through mouse host ports **32***a* to **32***d* and mouse host cables **17***a* to **17***d* respectively.

[0102] When not selected by the mouse channel select switch **35**, mouse device emulators **37***x* generates required keep alive traffic to prevent coupled computers **6***x* from disconnect the emulated keyboard device thus preventing re-enumeration delays once that emulator is selected again by the user.

[0103] Mouse device emulators **37***x* may be a microcontroller, ASIC, FPGA or any other suitable programmable device running a pre-programmed firmware. Both mouse host emulator **26** and mouse device emulators **37***x* may be implemented with ROM (Read Only Memory), Fuse protected flash, One Time Programmable (OTP) or other suitable non-volatile memory technology to prevent re-programming security attacks on controllers from the user mouse port **30** side or from the host mouse ports **32***x* side.

[0104] Mouse host emulator **26** is programmed to support only mouse (and optionally other pointing) devices. If the user or attacker attempts to connect a hub instead, the device will not be qualified and will be disabled. If the user or attacker attempts to connect a composite device having more than one peripheral functions to the user mouse port **30**, the mouse host emulator **26** will enumerate and enable only one mouse device contained in the composite device (if exist). If no mouse device exists in the composite device, then the whole device will be disabled.

[0105] Selector switch or push-buttons **19** is typically connected to the System Controller function **28**. System Controller function **28** manages the Secure KM Switch device **602** functionality through pre-programmed state-machine or firmware. System Controller function **28** may be implemented by microprocessor, a programmable logic device such as Programmable Logic Device (PLD) or Field-Programmable Gate Array (FPGA) or by simple discrete logic or an Application Specific Integrated Circuit (ASIC) circuitry.

[0106] Channel select line/lines **29** serves as address (selection) lines for the host channels. It may also drive the user display **13** indicating the selected channel through 7-segments or other type of numerical or graphical display. When the user selects a host channel through selector switch or push-buttons **19** or through key combinations, the system controller function **28** changes the KM channel select line/lines **29** to properly set the coupled keyboard channel select switch **36** and mouse channel select switch **35** to the user selected host. Controller function **28** may be also coupled with the keyboard host emulator **27** through line **25** to enable KM switching through predefined keyboard combinations or hot-keys. Controller function **28** detects pre-programmed key

patterns to trigger certain functions such as channel switching in addition to push-buttons **19** or as stand-alone function. Controller function **28** may be programmed to further detect user mouse keys or wheel movement to detect user inputs for channel select. For example a combination of left mouse key and mouse wheel rotation may be used to toggle between displays in a cyclic sequence.

[0107] Similar to some prior-art non-secure KM switches a remote control unit **505** may be added to reduce user desktop clutter and improve security. Cable **504** connects the remote controller **505** to the secure KM switch **602** system controller function **28**. Remote controller **505** having channel selection push buttons **506***x* and status LEDs **508***x* for each coupled computer. This remote controller **504** may be positioned on the user desktop while the secure KM switch **602** is remotely installed behind the desktop cabinets. Another option shown here is adding display top visual indicators such as LEDs or Electroluminescent panels **75***x* near each one of the user displays **2***x*. These display top indicators are coupled to the system controller function **28** similar to the remote controller **505** lights **508***x* to indicate the active computer selected by the user. In this figure computer **6***a* is being selected and therefore display top indicator **75***a* is illuminated.

[0108] It should be noted that in this figure and in all following figures switches symbols are used to clearly show function. In reality various multiplexers, discrete components, integrated circuits and various logical circuits may be used to achieve similar or same functionality.

[0109] Another optional feature of this exemplary secure KM switch is the use of the mouse cursor to enable user channel selection. Unlike prior-art KM switch illustrated in FIG. **5** above that requires Serial interconnect cables, this preferred embodiment of the current invention does not require any interconnect. This secure KM switch also does not have internal shared resources such as emulators that are susceptible to data leakages between channels.

[0110] Mouse device emulators **37***x* are configured in absolute mode (the cursor mode that is being used for touch-screen support).

[0111] It should be noted that standard computers and operating systems are typically operating with standard mouse using incremental cursor mode. In incremental cursor mode the location of the cursor is defined by the computer and not by the pointing device. The pointing device generates X-Y increments proportional to the user moves. There is a second mode that is being use primarily by computers having touch-screens. In this mode the pointing device controller passes to the coupled computer the exact location of the cursor on that display. This cursor mode called absolute mode as it delivers exact cursors X-Y coordinates based on the user inputs.

[0112] Using this absolute mode the cursor's absolute position rather than incremental changes are sent from the device emulators **37***x* to the coupled computers **6***x*. Host emulator **26** monitors the relative movements of the mouse and sums them up to computes the mouse pointer position. This mode enables mouse host emulator **26** to determine if the user moves the mouse cursor close to the display area border with the neighbouring display **2***x*. Once system controller function **28** was informed (using optional link **98**) of such display area border crossing by the mouse host emulator **26**, it changes the channel select line/s **29** accordingly to switch the user keyboard **3** and mouse **4** to the next channel. System controller function **28** must be pre-configured with the exact arrangement and size of displays **2***x* to detect display area border crossing properly. Once the channel is switched from display **2***x* to **2***y*, the absolute coordinates of mouse curser location on the selected display **2***y* are computed and transferred to mouse device emulators **37***y*. Since the mouse in the display **2***x* will be still shown to the user, to prevent multiple visible cursors, the system controller function may optionally instructs the non-selected computer **6***x* to hide the cursor by moving it to a hidden corner at the left or right bottom of the display. Optionally, as the mouse pointer crosses screens' boundary, the optional use of absolute pointer coordinates causes the pointer to reappear at the active display near the display boundary crossing location. As mentioned above this method of cursor movement detection does not require computers **6***x* serial interconnect or special software applications on installation and therefore it is much more secure.

[0113] Another optional feature that may be implemented in system controller function **28** is to prevent display boarder passing while mouse key is pressed. This feature may assist system usability preventing undesired switching while dragging and object or selecting multiple objects.

[0114] Number of unidirectional flow forcing circuitries **39** and **40** may be reduced by placing only one unidirectional flow forcing circuitry **39** between mouse host emulator **26** and mouse channel select switch **35** (or one 40 between 27 and 36, and similar implementations in embodiments depicted in later drawings). However, these implementations are less secure as switches **35**, **36**, etc. are typically a implemented as a microcontroller (integrated inside mouse host controller function). Therefore from security standpoint dedicated unidirectional diodes are preferred (unless channel select switches are replaced with tamper immune switches such as electromechanical relays or the likes).

[0115] FIG. **8** illustrates a high-level system **700** block diagram of a preferred embodiment of the current invention similar to the embodiment illustrated in FIG. **7** above. In this preferred embodiment several functions were integrated in order to reduce embodiment complexity and cost.

[0116] In this exemplary embodiment the keyboard host emulator **44** unidirectional serial output is routed into the mouse host emulator **45** where it is combined together with the mouse unidirectional serial output into a single serial data stream routed through channel select switch **41** into one of the 4 device emulators **48***a* to **48***d* after passing through a corresponding unidirectional flow forcing circuitry **46***a* to **46***d*. These device emulators serves as a composite device having one keyboard and one mouse device and it is coupled to the 4 computers **6***a* to **6***d* through host peripheral ports **15***a* to **15***d* and host peripheral cables **97***a* to **97***d* respectively. The integration of the unidirectional link generated by the keyboard emulator **44** and mouse emulator **45** reduces to half the number of:

[0117] Channel select switches;

[0118] Unidirectional enforcing circuitries;

[0119] Device emulators;

[0120] Host peripheral ports, and

[0121] Host peripheral cables.

[0122] Further reduction in components is possible with the integration of the system controller function together with the mouse emulator function in **45**.

[0123] While these changes have minor negative impact on the Secure KM switch **702** level of security, the cost and complexity reduction are significant.

[0124] FIG. **9** illustrates a high-level system **800** block diagram of an exemplary embodiment of the current inven-

tion similar to the system **700** and embodiment **702** illustrated in FIG. **8** above. This secure KM switch embodiment **802** is having an additional dedicated peripheral port **62** for special applications such as smart-card reader, biometric user authentication device, token, camera, docking station or any other allowed peripheral defined by the manufacturer or by the operator. To reduce clutter in this figure, only 2 channels secure KM **802** is shown. Therefore only 2 positions channel select switch **50** is used. Obviously this exemplary embodiment can be scaled to any required number of channels. In the following example a smart-card reader **66** is used.

[0125] For security reasons the whole dedicated peripheral port circuitry is contained in the dedicated peripheral port security function **804** and isolated from other circuitry of the secure KM switch **802**.

[0126] Smart-card reader device **66** having a smart-card or Common Access Card (CAC) **68** in this example is coupled through a cable **65** into a dedicated peripheral port **62**. Dedicated peripheral port **62** is typically a USB port or any other serial peripheral protocol. Dedicated peripheral port **62** is coupled to the dedicated peripheral port mode selector switch **57** through lines **51**. Lines **51** may have ESD protection means, EMI filters and other electrical and safety protection means not shown here to prevent cluttering. Dedicated peripheral port mode selector switch **57** initially couples the dedicated peripheral port **62** to the qualification microcontroller function **54** that also drives the dedicated peripheral port mode selector switch **57**. Qualification microcontroller function **54** enumerates the peripheral device that is coupled to the dedicated peripheral port **62** to determine if it is an allowed device based on pre-programmed qualification criteria.

[0127] This pre-programmed qualification criteria may use one or more of the following peripheral device characteristics:

[0128] 1. Device class

[0129] 2. Device sub-class

[0130] 3. Device vendor ID

[0131] 4. Device model ID

[0132] Preferably or optionally, in case that the device is a smart-card reader **66**, the pre-programmed qualification criteria applies only to the reader not to the card **68** as the card is qualified and authenticated by the coupled computer **6***x*.

[0133] To enable certain operation flexibility, the dedicated peripheral port security function **804** pre-programmed qualification criteria may be partially or fully field-programmable. Field programming can be done through a secure device learning process or data entry using various methods. In some embodiment of the present invention initial pre-programming residing on Read Only Memory (ROM) or One-Time Programmable (OTP) memory may include device classes OBh (USB smart card reader) and ODh (Finger Print Reader) as qualification criteria. More detailed criteria may be field programmer to add device sub-classes, Vendor ID and Product ID for example.

[0134] After successful qualification of the coupled smart-card reader device **66**, the qualification microcontroller function **54** drives the dedicated peripheral port mode selector switch **57** to couple the user dedicated peripheral port **62** to the peripheral monitoring function **58** and the dedicated peripheral port channel select switch **55**. The dedicated peripheral port channel select switch **55** controlled by the system controller function **45** through channel select line/s **29**, optional freeze function **61** and lines **56**. The dedicated peripheral port channel select switch **55** couples the connected device to one of the coupled hosts **6***a* and **6***b* ports through dedicated peripheral host ports **60***a* and **60***b* and cables **59***a* and **59***b* respectively. The optional freeze function **61** connected between the system controller function/mouse host emulator **45** and the dedicated peripheral port channel selection switch **55**. Once the user presses the freeze function push-button **67**, the last channel selected is latched and from that moment the dedicated peripheral port selected channel is freezing. The user may select another channel while the dedicated peripheral port remains on the same channel. This feature may be useful to enable the user to remain connected to a session requiring user authentication session using device **66** while interacting with other channels through the keyboard **3** and mouse **4**. Freeze status indicator may be added to **67** to provide clear indication when device is in freeze mode.

[0135] The peripheral monitoring function **58** continuously monitors the dedicated peripheral port **62** traffic to detect abnormalities such as device disconnect or device reset. The peripheral monitoring function **58** is coupled on the other side to the qualification microcontroller function **54**. In case that the peripheral monitoring function **58** detects an abnormal port situation or activity, it signals the qualification microcontroller function **54**. The qualification microcontroller function **54** then commands the dedicated peripheral port mode selector switch **57** to switch back to the qualification microcontroller function **54** and start requalification. Optionally, alarm or alert message is issued once abnormal port situation or activity is detected.

[0136] The peripheral monitoring function **58** may be implemented using one or more of the following exemplary functions:

[0137] 1. A managed USB hub wherein one downstream port is coupled to the dedicated peripheral port mode selector switch **57** and the upstream port is coupled to the dedicated peripheral port channel select switch **55**. USB hub **58** may be coupled through hub status LED output or I^2C management bus to the qualification microcontroller function **54** to report downstream port status and port abnormalities. USB hub may detect and report abnormalities such as: over-current fault, device disconnect, device reset, host reset etc.

[0138] 2. A microcontroller having upstream and downstream peripheral ports may be used to analyze traffic passed through and detect abnormal situations similar to the USB hub above. The microcontroller **58** may be coupled to the qualification microcontroller function **54** through serial or discrete I/O.

[0139] 3. An FPGA having upstream and downstream peripheral ports may be used to analyze traffic passed through and detect abnormal situations similar to the USB hub and microcontroller above. The FPGA **58** may be coupled to the qualification microcontroller function **54** through serial or discrete I/O.

[0140] Qualification microcontroller function **54** may be implemented using a microcontroller, ASIC, FPGA or any other suitable programmable device running a pre-programmed firmware. Qualification microcontroller function **54** may be also be implemented to contain additional functions such as the dedicated peripheral port mode selector switch **57** and the peripheral monitoring function **58**. Coupled device disconnect can be detected using electrical or mechanical disconnection detection function that is coupled to the qualification microcontroller function **54**. This function

may detect USB connector disconnection by sensing ground continuity or current flow to the coupled device. This additional monitoring may be needed to augment the peripheral monitoring function **58** during time intervals that device is not enumerated by the computer (for example during computer boot).

[0141] It should be noted in the above example only the smart-card reader **66** is being enumerated, qualified and monitored by dedicated peripheral port security function **804**. The smart-card **68** is not part of this process. Smart-card **68** uses smart-card reader **66** like a pipe or tunnel wherein all secure authentication traffic is passed through. Smart-card **68** authentication is performed by the computers **6***x*. Similarly, when reader **66** is a biometric reader such as fingerprint reader, it is generally the reader that is qualified and isolated by the dedicated peripheral port security function **804**, while the verification and authorization/rejection of the biometric data is performed elsewhere as known in the art.

[0142] Optional dedicated peripheral port status light **64** is driven by the qualification microcontroller function **54** provides user indication of port status. For example a bi-color LED may be used to provide the following indications:

[0143] Off—port is not used

[0144] Blinking green—device qualification in progress

[0145] Steady green—device qualified and ready for use

[0146] Steady red—device is unqualified

[0147] Optionally, additional port or ports, similar to dedicated peripheral port function may be implemented to support other dedicated peripheral functions such as touch-screen or document scanner. In this case the qualification controller may be preprogrammed at the factory or in the field to enable device customization. Security function field programming may be protected from unauthorized user modification through user name and password, smart-card, special token etc. To prevent unauthorized use of this dedicated port, the port is enabled only if the connected device is the device defined by the pre-programmed qualification characteristics.

[0148] Another feature of the current invention illustrated in this figure is the Remote Desktop Controller (RDP) port **42**, coupled to the system controller/mouse host emulator **45**. This port provides external power and communications to support cable-connected remote controller/indicator. For example, the cable-connected remote controller/indicator may be similar to remote controller **505** seen in FIG. **5**. Some or all secure KM switch **802** control and monitoring functions may be extended to a remote location where user desktop located.

[0149] FIG. **10** illustrates a high-level system **900** block diagram of a preferred embodiment of the current invention similar to the system **700** and embodiment **702** illustrated in FIG. **8** above. This exemplary secure KM switch embodiment **902** is having an additional audio switching function and active anti-tampering system.

[0150] The optional audio switching or mixing function may be added to the Secure KM switch **902** in order to enable user to operate audio peripherals such as earphones, microphone, headset **76** or speakers. Computers **6***a* and **6***b* having additional audio cables **74***a* and **74***b* connected to the Secure KM switch **902** audio input (output, or input/output) ports **71***a* and **71***b* respectively. Cables **74***x* may couple audio out, audio in, microphone or other digital or analog audio signal. Audio switch/multiplexer/mixer **70** enables volume control of selected/unselected hosts based on programmed settings through channel select lines **29** driven by the system controller function/mouse host emulator **45**. Audio switch/multiplexer/mixer **70** may be implemented by a simple relay or analog switch to enable audio channel on-off switching. Alternatively audio switch/multiplexer/mixer **70** may be implemented by a programmable mixer or attenuator to enable dynamic volume control.

[0151] For example selected computer audio channel may have higher volume compared to other host audio signals. In some exemplary embodiments, audio signals comprises of speaker signals transmitted to the user speaker, but no microphone signals. By allowing only speaker signals, unidirectional signal flow and security can be ensured. It should be noted that if microphone switching circuitry is not implemented inside the secure KM switch **902** enclosure for security reasons, external microphone switcher accessory may be added to enable user microphone control by using the embodiment RDC port **42** shown in FIG. **9** above. External microphone switcher accessory may receive channel select commands from secure KM switch system controller function or mouse host emulator **45** and coupled to the computers **6***x* microphone inputs and to the user microphone device **76**.

[0152] In some embodiments, Secure KM switch is further comprises of active anti-tampering circuitry to detect tampering events and to permanently disable the device. Tampering sensor **82** may be a micro-switch, light sensor, shielding net sensor, x-ray sensor, temperature sensor or other physical intrusion detection capable component or a combination of several such sensors. The tampering sensor **82** is coupled to the anti-tampering controller **84** that is powered by the secure KM switch **902** power supply or by backup power source **80**. Backup power source may be rechargeable battery, non-rechargeable battery, super capacitor or another energy storage component. The anti-tampering controller **84** is connected to the system controller/mouse host emulator **45**, preferably in such way that it will trigger an irreversible effect on the system once triggered. Typical tampering effect is complete product disable while all front panel indicators are blinking to indicate tampering event. Additional tampering evident means such as tampering evident labels may be added to the product to indicate potential tampering. Further enhancement of system **900** security may be achieved by the additional Trusted Platform Module (TPM) **77**. This industry standard or proprietary security module may interact with the anti-tampering controller **84** on one side and with one of the device emulators to provide advanced security functions such as:

[0153] Tampering logging

[0154] Tampering alarms

[0155] Attack alarms

[0156] Trust chaining of the secure KM switch with one or more of the trusted coupled hosts **6***x*

[0157] FIG. **11** illustrates a high-level system **1000** block diagram of a preferred embodiment of the current invention identical to the preferred embodiment **702** of FIG. **8** above wherein two out of the four coupled computers are configured to support dual displays. In this system **1000** the user is working through the secure KM switch with total of 6 displays. Display **2***ap* is the primary display coupled to computer **6***a* through video out cable **8***ap*; Display **2** as is the secondary display coupled to computer **6***a* through video out cable **8** as; Display **2***b* is the display coupled to computer **6***b* through video out cable **8***b*; Display **2***c* is the display coupled to computer **6***c* through video out cable **8***c*; Display **2***dp* is the primary display coupled to computer **6***d* through video out

cable **8***dp*; Display **2***ds* is the secondary display coupled to computer **6***d* through video out cable **8***ds;*

[0158] As some operating systems may not support absolute mode with dual displays, it may then be needed to load special driver application **96***a* on computer **6***a* and **96***d* on computer **6***d* to enable channel selection through cursor tracking by secure KM switch **702**. The special driver application **96***x* sets the computer **6***x* to operate in absolute mode and thus to enable smooth cursor transition between displays such as the right border of display **2** as and the left border of display **2***b*.

[0159] FIG. **12** illustrates an exemplary front panel of a 4 channels Secure KM switch such as **602**, **702**, **802** and **902** of FIGS. **7** to **11** above in this specific exemplary embodiment of the present invention. It should be noted that the embodiments may have more or less channels as required for the specific application.

[0160] Front panel **80** is preferably having the following features:

[0161] Channel select push-buttons **19***pa*, **19***pb*, **19***pc* and **19***pd* enable manual user selection of coupled computers **6***a* to **6***d* respectively. Channel select push-buttons **19***px* may be implemented using switches, metal domes, silicon keypad, touch switches or any other suitable technology. The optional markings "1" to "4" above push-buttons **19***pa*, **19***pb*, **19***pc* and **19***pd* indicate the hosts **6***a-d* respectively. This convention will be used in some of the following discussion.

[0162] Channel selected indicator lights **19***ia*, **19***ib*, **19***ic* and **19***id* provides visual indication of the current selected computers **6***a* to **6***d* respectively. Channel selected indicator lights **19***ix* may be LED (Light Emitting Diodes) or any other user indication technology.

[0163] Dedicated peripheral port **62** is typically a USB type-A jack available to connect qualified user peripheral devices.

[0164] Dedicated peripheral port channel selected indicator lights **67***a* to **67***d* provides user indications of the current dedicated peripheral port channel selected between computers **6***a* to **6***d* respectively. Dedicated peripheral port channel selected indicator lights **67***x* may be LED (Light Emitting Diodes) or any other user indication technology. It should be noted that channel selected indicator lights **19***ix* indicates which computer **6***x* is currently selected, and is currently responsive to keyboard and mouse commands. This selection is controlled by selectors **19***px* and/or mouse and/or keyboard commands. Dedicated peripheral port channel selected indicator lights **67***x* indicates which computer is currently selected to interact with the authentication device such as card reader **66**. This selection is influenced by pressing the freeze push-button **67**.

[0165] Dedicated peripheral port status indicator light **67***i* provides user indication of the port status. Indication may include normal mode, failure mode (device rejected), freeze mode and off status.

[0166] Freeze push-button or switch **67** enable user selection of dedicated peripheral port freeze-unfreeze status.

[0167] RDC port connector **42** may be used to connect Remote Desktop Controller/indicator device.

[0168] Tampering evident label **81** provides permanent visual indications of mechanical tampering attempt. These labels are designed to provide clear and irreversible indications once peeled-off, moved or damaged as a result of mechanical stress on the product enclosure surface.

[0169] Channel selected 7-segments indicator **13** provides channel selected number indication to the user.

[0170] FIG. **13** illustrates an exemplary rear panel of a 4 channels Secure KM switch such as **602**, **702**, **802** and **902** of FIGS. **7** to **11** above in this specific exemplary embodiment of the present invention. It should be noted that embodiment may have more or less channels as required for the specific application.

[0171] The optional markings "Host 1" to "Host 4" refers the computers **6***a-d* respectively.

[0172] Rear panel **92** is preferably having the following features:

[0173] USB Type-A user (console) keyboard connector **31***a* and PS/2 mini-DIN connector **31***pa* to enable connection of a standard USB or PS/2 keyboard device.

[0174] USB Type-A user (console) mouse connector **30***b* and PS/2 mini-DIN connector **30***pb* to enable connection of a standard USB or PS/2 mouse device. Audio out jack 3.5 mm stereo **72** to enable connection of user headset or speakers. An additional microphone input jack may be added if needed (not shown here).

[0175] USB Type-B Host 1 to 4 peripheral port **15***a* to **15***d* to enable connection of computers **6***a* to **6***d* respectively.

[0176] USB Type-B Host 1 to 4 dedicated peripheral port **60***a* to **60***d* (or card reader port) to enable connection of computers **6***a* to **6***d* respectively.

[0177] Audio in jack 3.5 mm stereo Host 1 to 4 ports **15***a* to **15***d* to enable audio connection from computers **6***a* to **6***d* respectively.

[0178] DC jack **82** to enable connection of external wall mounted or brick type AC to DC power supply.

[0179] Tampering evident label **83** provides permanent visual indications of mechanical tampering attempt. These labels are designed to provide clear and irreversible indications once peeled-off, moved or damaged as a result of mechanical stress on the product enclosure surface.

[0180] FIG. **14** illustrates an exemplary display arrangement **90** of a 4 channels such as used in systems **500**, **600**, **700**, **800** and **900**; with Secure KM switch such as **602**, **702**, **802** and **902** of FIGS. **7** to **11** above according to embodiments of the present invention. This exemplary display arrangement is brought here to provide more detailed information about the cursor tracking channel select mode of the present invention.

[0181] To illustrate the cursor tracking channel select mechanism, this FIG. **14** will follow a cursor path moved by the user from start point **92** to endpoint **94** across all 4 displays **2***a* to **2***d*.

[0182] When the cursor is located in the start point **92** the Secure KM switch selected channel is 1 (computer **6***a*). Cursor absolute location and keyboard key-codes are routed to computer **6***a*. Once the user moved the cursor across display **2***a* right border (cross point **91***a*) the Secure KM switch disconnect keyboard and mouse data to computer "1" (**6***a*) and route it to computer "3" (**6***c*). Cursor absolute location in display **2***c* is calculated to the exact vertical point that the cursor was before crossing at display **2***a* (same height). This reappearance of the cursor in display **2***b* creates to the user the illusion that the desktop space is continuous.

[0183] Once the user further moved the cursor across display **2***c* top border (cross point **91***b*) the Secure KM switch disconnect keyboard and mouse data to computer **6***c* and route it to computer "2" (**6***b*). Cursor absolute location in display **2***b* is calculated to the exact lateral point that the cursor was before crossing at display **2***c*.

[0184] Similarly once the user further moved the cursor across display **2***c* lower border (cross point **91***c*) the Secure KM switch disconnect keyboard and mouse data to computer **6***b* and route it to computer **6***c*. Cursor absolute location in display **2***c* is calculated to the exact lateral point that the cursor was before crossing at display **2***b*. Similar process takes place at crossing points **91***d* and **91***e* until the cursor stops in display **2***c* while Secure KM switch route keyboard and mouse data to computer **6***c*.

[0185] It should be noted that when computers **6***x* are not selected by the Secure KM switch, still their coupled device emulators optionally performing one or both of:

[0186] 1. Generating required periodic keep alive traffic to prevent a situation that the port/device will be disabled by the coupled computer **6***x*.

[0187] 2. Hiding the non-active cursor for example by sending an absolute position to locate the cursor at one of the extreme display corners.

[0188] In the depicted exemplary embodiment, since display **4** (**2***d*) is larger size, display border crossing lines must be calculated to provide a smooth and continuous line at crossing points **91***d* and **91***e*. At crossing point **91***d* mouse cursor speed should be reduced to compensate for the larger display **4** (**2***d*), and vice versa in crossing point **91***e*.

[0189] As pointer motion is fully controlled by the secure KM switch and not by coupled computers, user pointer speed and acceleration may be adjusted by the user through programming means to provide maximum comfort.

[0190] The secure KM switch of the present invention may use entered display settings to further enhance user experience by regulating the cursor moving speed across the different displays. As displays may be larger or smaller, cursor movement should be adjusted to prevent speed and acceleration changes.

[0191] FIG. **15** illustrates an exemplary method to be used to enable 4-ports secure KM switch displays setting programming according to an embodiment of the current invention assuming all displays are similar size and resolution for simplicity.

[0192] In this example, the displays matrix **93** comprises up to 8 lines or just 3 lines in this particular example (designated A to C) and up to 8 rows (designated 1 to 8) of user displays **2***x*. To enable Secure KM switch customization to specific installation display setup, the operator may enter an initialization string containing the exact location/designation of each attached display. The exemplary string **87** is aligned to the left in this example. In this example computer **1** (**6***a*) is dual displays having a primary display located at matrix cell 1A and a secondary display located at matrix cell 2A. The resulted initialization string of this example is marked in string **87** as "1P=1A;1S=2A;". Similarly, computer **2** (**6***b*) has a single display located at matrix cell 2B as indicated by "2-2B;" in string **87**.

[0193] Initialization string entry may be performed by the product operator though one or more of means such as:

[0194] 1. Keyboard entry using special keys sequence to enter programming mode and then additional keys typing to enter required setting codes.

[0195] 2. Mass storage device having initialization file coupled to the secure KM switch for example instead of the user keyboard or mouse. USB flash drive may be used to deliver programmed settings to multiple secure KM devices.

[0196] 3. Bar-code reader, for example connected instead of the user keyboard to emulate standard keyboard using printed bar-code patterns in the user's manual.

[0197] 4. Front panel or remote desktop controller switches or graphic user interface.

[0198] 5. Dedicated programming tool or cable

[0199] 6. Connection to a PC having initialization program or file through a dedicated or standard cable.

[0200] 7. Smart-card having initialization file entered into a standard reader that is coupled into the user mouse or keyboard ports or into the RDC port.

[0201] Computer application may be provided with the secure KM switch to enable display configuration setting together with other system or user customization parameters. Once application saves required user programmed settings it may be coupled to the secure KM switch through a cable to transfer entered configuration. Last configuration entered by the user is then stored in a non-volatile memory integrated or coupled to the said system controller function.

[0202] FIG. **16** illustrates an exemplary method to be used to enable 4-ports secure KM switch displays and user settings programming according to an embodiment of the current invention assuming displays of various sizes.

[0203] In this example, the displays matrix **95** comprises of a grid having 22 vertical lines marked from 1 to 22 and 22 horizontal lines marked from A to V. Larger o smaller matrix may be used to enable proper display arrangements as needed. To enable Secure KM switch customization to specific installation display setup, the operator may enter numerically or graphically an initialization string containing the exact location/designation of each attached display left bottom and right top corners. The exemplary string **97** is aligned to the matrix origin in this example. In this example computer **1** (**6***a*) is configured to drive a single display located at: Left bottom corner at 1A; Right top corner at 9G. All other 3 displays location described in a similar way. The resulted initialization string of this example is 1=1A-9G;2=9A-19J; 3=9J-22U;4=1G-9N. Additional user settings such as cursor speed (=5) and cursor acceleration (=8) may be added to enable further customization. String **97** may be programmed directly into the secure KM switch device or prepared on local or web application and then loaded into the secure KM switch device/s.

1. A Secure KM switch apparatus comprising:

a user keyboard port capable of interfacing with a user keyboard;

a keyboard host emulator to emulate computer host coupled to user keyboard port on one side and to keyboard channel select switch on the other side;

at least one unidirectional flow forcing circuitry to assure that data is only flowing from keyboard channel select switch to coupled keyboard device emulators and no other data may flow from the keyboard device emulators back to the keyboard channel select switch and to the coupled keyboard host emulator;

a keyboard channel select switch controlled by System Controller function to connect only one selected channel keyboard device emulator to the said unidirectional flow forcing circuitry at a time;

a plurality of keyboard device emulators, to emulate a standard keyboard or replicated identity of user keyboard for each one of the coupled computer channels through host keyboard ports;

a plurality of host keyboard ports for coupling coupled computers through cables;

a user mouse port to connect a standard user mouse or pointing device;

a mouse host emulator to emulate computer host coupled to user mouse port on one side and to mouse channel select switch on the other side;

at least one unidirectional flow forcing circuitry to assure that data is only flowing from said mouse channel select switch to coupled mouse device emulators and no other data may flow from the mouse device emulators back to the mouse channel select switch and to the coupled mouse host emulator;

a mouse channel select switch controlled by System Controller function to connect only one selected channel mouse device emulator at a time to the said unidirectional flow forcing circuitry;

a plurality of mouse device emulators to emulate standard mouse device for each one of the coupled computer channels through host mouse ports;

a plurality of host mouse ports for coupling coupled computers through cables; and

a System Controller function to control said keyboard channel select switch and mouse channel select switch based on user inputs.

2. The Secure KM switch apparatus of claim **1**, wherein channel selection user input is provided by selectors such as: at least one switch located at the apparatus front panel, at least one switch located in a remote controller, mouse keys or wheel and pre-programmed keyboard key combinations.

3. The Secure KM switch apparatus of claim **1**, wherein the apparatus is capable of operating in cursor tracking mode wherein channel select is extracted from mouse cursor position and path analysis compared to pre-programmed displays arrangement to provide the user with the visual illusion of a single continuous desktop workspace across different isolated displays coupled to isolated computers.

4. The Secure KM switch apparatus of claim **3**, wherein said cursor tracking mode comprises a function to hide inactive cursor pointer by method selectable from the list comprising of: moving inactive cursor to one of the display extreme corners, signaling the coupled computer mouse driver to hide the cursor.

5. The Secure KM switch apparatus of claim **3**, wherein said cursor tracking mode comprises a function enable constant speed and acceleration of the user cursor based on user preprogrammed displays size, speed preference, and acceleration preference.

6. The Secure KM switch apparatus of claim **1**, wherein said mouse device emulators and keyboard device emulators are sending keep-alive packets to coupled computers when not selected by the user to prevent peripheral device disconnection and re-enumeration.

7. The Secure KM switch apparatus of claim **1**, further having user audio switching functions selected from a group comprising audio output switching, audio output mixer, microphone input switching, remote microphone input switching.

8. The Secure KM switch apparatus of claim **1**, further having Anti-tampering selected from a group of anti-tampering such as: active anti-tampering with at least one tampering sensor, tamper evident paint, tamper evident labels, Trusted Platform Module to enable tampering event logging and platform authentication.

9. The Secure KM switch apparatus of claim **1**, further having Remote Desktop Controller (RDC) Port to support external devices selectable from the list comprising of: remote desktop controller, remote display top indicator, external microphone input switcher, and remote management or programmer computer.

10. The Secure KM switch apparatus of claim **1**, further having a software driver component to be installed in at least one coupled computer to support dual display operation in cursor tracking operating mode and to enable inactive cursor hiding.

11. The Secure KM switch apparatus of claim **1**, wherein keyboard host emulator, mouse host emulator and system controller function are integrated into a single microcontroller, keyboard and mouse unidirectional flow enforcing circuitries are integrated into one circuit and keyboard and mouse channel select switches are integrated into one channel select switch and keyboard and mouse device emulators are integrated into one set of device emulators per host port configured as composite devices;

12. The Secure KM Switch of claim **1**, further having at least one dedicated peripheral port security function comprising:

a dedicated peripheral port to connect a qualified user peripheral device;

a dedicated peripheral port mode switch to couple the said dedicated peripheral port to a qualification microcontroller while in qualification mode or to channel select switch and port monitor function while in normal mode; and

a qualification microcontroller function to emulate computer host to allow coupled peripheral device enumeration and qualification and upon successful qualification commanding said user authentication device peripheral switch to couple the dedicated peripheral port to the said computer peripheral port.

13. The Secure KM switch of claim **12**, wherein said dedicated peripheral port security function further comprises an additional port monitoring circuitry, said monitoring circuitry is coupled to the qualification microcontroller to enable detection of coupled peripheral device disconnect and to command the coupled dedicated peripheral port mode switch to switch back to the qualification microcontroller function.

14. The Secure KM switch of claim **13**, wherein said additional monitoring circuitry comprises at least one of a group comprising a monitor-able USB hub, mechanical connector detector, device ground detector, and device current detector.

15. The security function of claim **11**, wherein qualification controller, host emulator, and device emulator are field programmable to enable field customization to specific peripherals.

16. The Secure KM Switch apparatus of claim **5**, wherein System Controller function display arrangement and other customizable device settings are field upgradeable through means selectable from a list comprising keyboard entries, external programmer, bar-code reader, coupled mass-storage device, c, coupled computer, front-panel GUI, remote desktop controller or user calibration process.

17. A secure multi-computer system using a KM switch comprising a secure KM switch apparatus, the secure multi-computer system comprising:

a user keyboard port capable of interfacing with a user keyboard;

a keyboard host emulator to emulate computer host coupled to user keyboard port on one side and to keyboard channel select switch on the other side;

at least one unidirectional flow forcing circuitry to assure that data is only flowing from keyboard channel select switch to coupled keyboard device emulators and no other data may flow from the keyboard device emulators back to the keyboard channel select switch and to the coupled keyboard host emulator;

a keyboard channel select switch controlled by System Controller function to connect only one selected channel keyboard device emulator to the said unidirectional flow forcing circuitry at a time;

a plurality of keyboard device emulators to emulate a standard keyboard or replicated identity of user keyboard for each one of the coupled computer channels through host keyboard ports;

a plurality of host keyboard ports for coupling coupled computers through cables;

a user mouse port to connect a standard user mouse or pointing device;

a mouse host emulator to emulate computer host coupled to user mouse port on one side and to mouse channel select switch on the other side;

at least one unidirectional flow forcing circuitry to assure that data is only flowing from said mouse channel select switch to coupled mouse device emulators and no other data may flow from the mouse device emulators back to the mouse channel select switch and to the coupled mouse host emulator;

a mouse channel select switch controlled by System Controller function to connect only one selected channel mouse device emulator at a time to the said unidirectional flow forcing circuitry;

a plurality of mouse device emulators to emulate standard mouse device for each one of the coupled computer channels through host mouse ports;

a plurality of host mouse ports for coupling coupled computers through cables; and

a System Controller function to control said keyboard channel select switch and mouse channel select switch based on user inputs;

at least a first and a second mutually isolated computer systems, each comprising:

a computer having:

a computer keyboard port coupled through said cables to said respective host keyboard port;

a computer mouse port coupled through said cables to said respective host mouse port; and

a display coupled to said computer,

wherein only one of said first and second computer systems is controlled by said user keyboard and user mouse at the time, and wherein no information may be exchanged between said first and second mutually isolated computer systems through said secure KM switch apparatus.

18. The secured multi-computer system using a KM switch of claim **17**, wherein said first and second computer systems are connected to a first and second different networks, and wherein no information may be exchanged between said first and second networks through said secure KM switch apparatus.

19. A method of securely coupling a plurality of computer systems to a single keyboard and a single mouse comprising:

connecting a single user mouse a host emulator capable of extracting mouse commands from said user mouse;

selecting one of a plurality of isolated computer systems to receive said extracted mouse commands;

passing said extracted mouse commands to said selected isolated computer system through a unidirectional flow forcing circuitry and a device emulator.

20. The method of claim **19**, further comprising:

connecting a single user keyboard a host emulator capable of extracting mouse commands from said user keyboard; and

passing said extracted keyboard commands to said selected isolated computer system through a unidirectional flow forcing circuitry and a device emulator.

21. The method of claim **20** wherein:

said passing said extracted keyboard commands to said selected isolated computer system is through a keyboard device emulator; and

said passing said extracted mouse commands to said selected isolated computer system is through a mouse device emulator.

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